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## THESIS

A COST BENEFIT - ANALYSIS OF ESTABLISHING A  
WAREHOUSE FACILITY FOR THE SERVICES  
DIVISION OF THE DIRECTORATE OF PERSONNEL  
AND COMMUNITY ACTIVITIES AT FORT ORD,  
CALIFORNIA

by

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and  
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June, 1990

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Standardization, Economic Order Quantities, Savings from bulk purchases, Centralization of ordering.

The Assistant Director for Community Family Activities (DCFA) at Fort Ord Army Base requested a cost-benefit analysis to determine if the Services Division of CFA should establish a warehouse operation. This study determined the feasibility of standardizing certain non-perishable products procured with Non Appropriate Fund (NAF) resources, buying them in bulk and issuing them through a new warehouse facility.

The analysis of available data indicates that it is not economically justifiable to establish a new warehouse facility in order to make large quantity purchases with subsequent distribution to customer activities.

In view of the conclusion, this study provides several cost saving measures which, if adopted by the organization, will result in substantial savings in outlays.

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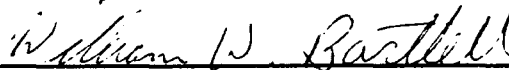
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A Cost - Benefit Analysis of Establishing a Warehouse Facility  
for the Services Division of the  
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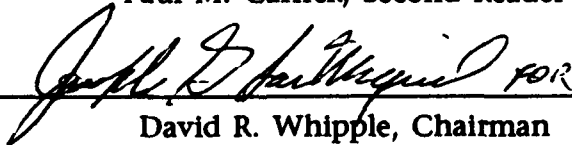
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## ABSTRACT

The Assistant Director for Community Family Activities (DCFA) at Fort Ord Army Base requested a cost - benefit analysis to determine if the Services Division of CFA should establish a warehouse operation. This study determined the feasibility of standardizing certain non-perishable products procured with Non Appropriated Fund (NAF) resources, buying them in bulk and issuing them through a new warehouse facility.

The analysis of available data indicates that it is not economically justifiable to establish a new warehouse facility in order to make large quantity purchases with subsequent distribution to customer activities.

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## **I. INTRODUCTION AND BACKGROUND**

An effective organization is one which achieves its objectives in the most cost-efficient manner. This study will determine if the current system of procurement for consumable products<sup>1</sup> used by the Non Appropriated Fund Activities of the Community Family Activities (CFA) Department, Fort Ord, California, is the most cost efficient method or whether a centralized and single source procurement system, with distribution through a warehouse, would prove to be more effective. Because of time and resource constraints, this study will only be concerned with non-perishable, repetitive use items that might be standardized, purchased, stocked and issued through a central warehouse facility.

A warehouse is being considered because it provides a focal point for receiving, storing, and distributing goods, and provides an opportunity for centralized inspection of supplies at time of receipt to verify specifications, condition and count. In addition, a warehouse will allow for prompt routing of receiving reports to take advantage of cash discounts.

The methodology used to determine if the establishment of a warehouse would be economically justifiable consists of a three step process. The first step requires the identification of those items that are used in sufficient quantities to be consolidated into

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<sup>1</sup>Consumable products are merchandise and supplies for which there is a frequently recurring need over time. This category includes, but is not limited to, items such as disposable beverage containers, paper products of all descriptions and cleaning supplies. (AR215-5,p.A-8)



standardized products, purchased in bulk and distributed through a warehouse facility. The second step determines the cost of those standardized items as they are purchased in the current system and compares that to the cost of procuring them in the quantities that would be procured for a warehouse system. The final step is a comparison of the savings generated by bulk purchasing, with the cost of establishing and operating a warehouse.

Chapter One is three fold in purpose: to provide background information on the organization of the Community Family Activities Department; to describe the current method of procurement and funding; and, to summarize the reasoning for recommending a change to the present system of procuring non-perishable, consumable products.

## **A. ORGANIZATION OF THE COMMUNITY FAMILY AFFAIRS DEPARTMENT**

CFA is organized into six divisions that either provide services to members of the armed services and their dependents directly, or provide administrative support to the department. All are considered to be nonappropriated fund instrumentalities (NAFI) in that they use some level of nonappropriated funds (NAF)<sup>2</sup> to contribute to the morale, welfare, and recreational programs of other authorized organizations. The Morale Welfare and Recreation (MWR) system consists of:

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<sup>2</sup>Nonappropriated funds are cash and other assets received by nonappropriated fund instrumentalities from sources other than monies appropriated by the Congress of the United States.  
(AR215-5,p.3)

Activities on military installations that provide for the comfort, pleasure, and mental and physical improvement of DOD personnel. These activities include recreational and free time programs, self -development programs, resale merchandise and services and general welfare.(AR 215-5,1988,p.12)

The source of operating funds for the activities within each division is a fundamental precept in determining which activities in the department will be involved in a warehouse operation. Regulations dictating categories and types of MWR Activities require that those activities that are mission sustaining or basic or enhanced community support activities, receive a substantial amount of appropriated fund (APF)<sup>3</sup> support to fund them in whole or to augment revenues generated by their activities. The other category consists of those activities that are comparable to self-sustaining businesses which are capable of funding most of their expenses. Although a warehouse with an APF and NAF funded inventory is feasible, this study only considers an operation that is solely operated with NAF money.

All activities within the CFA department are funded in whole or in part with either APF or NAF. Of the six divisions in the department, three are supported primarily through nonappropriated funding and are considered to be business activities; Community Operations, Guest Billeting and Services. The activities within the other three divisions are funded for the most part, with appropriated funds.

The Community Operations division consists of the Officer and Enlisted Clubs at Fort Ord, the Presidio of Monterey and Fort Hunter Ligget, and the golf course, flower shop and bowling alley at Fort Ord. The activities in this division would be

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<sup>3</sup>Appropriated funds are monies made available to the military departments by the Congress of the United States.(AR215-5,p.2)

the primary users of a warehouse facility. The clubs and the golf course are heavy users of kitchen type cleansers, detergents and grease cutters, beverage containers and napkins. All the activities require lavatory and general purpose cleaning products.

Guest Billeting provides boarding facilities for transient military personnel and their dependents and could also benefit significantly by participating in a warehouse facility. Their primary common item requirements are general purpose cleaners, lavatory products and laundry detergents.

The Services Division of the CFA department is tasked with providing centralized general support services, to include "...NAF purchasing and contracting...and warehousing."(Ft Ord Reg 10-2) They negotiate or authorize all purchases for materials and services funded by nonappropriated funds for all activities in the CFA department. Services Division currently has a 400 square foot warehouse facility integral to their office building. It is used for storage and issuing of several commonly used products such as adding machine tape, copying paper and resale cigarettes. This division would be responsible for the entire operation of a warehouse facility or distribution dock.

## **B. CURRENT PROCUREMENT PROCEDURES**

In order to understand the changes that would be necessitated by the establishment of a warehouse, one must understand the current procurement system as it applies to the products of interest.

All non-perishable, high usage consumable products are currently procured by one of four methods: Blanket Purchase Agreement (BPA), Contract, Purchase Order, or with petty cash. BPAs are the primary transaction method, followed by the use of petty

cash and less frequently, Purchase Orders. Contracts are primarily used to provide for services such as maintenance and cleaning, both of which often include a supply of non-perishable high use consumable items.

BPA's provide a simplified method of making small purchases in the open market. By establishing a "charge account" with a vendor, they eliminate the need for repetitive issuance of individual purchase orders, thus reducing administrative costs. They have the effect of a charge account but they are not binding contracts and do not obligate the activity to purchase the supplies or services named in the agreement.(AR215-4,1988,p.15)

BPA's have been arranged with local commercial vendors as well as with the Commissary, the Army/Air Force Post Exchange, Troop Issue (TI) and the Self Service Supply Store (SSSC). TI provides food products to armed forces units and MWR activities. Similarly, SSSC provides a consolidated point of distribution for specified expendable supplies to activities authorized logistical support at the installation. There are currently over one hundred BPA's available for use by the activities in the CFA department.

Petty cash is often used to purchase small quantities of office and cleaning materials when they are not available in a timely period from normal sources.

The managers of each activity either personally make purchases through BPA's and with petty cash, or authorize a member of their organization to do so. Purchases are made on an as required basis determined by visual inspection of inventory levels and are either delivered by a vendor or in the case of the Commissary, Exchange and SSSC, picked up by the customer activity.

Purchase Orders have been occasionally used to negotiate and purchase large quantities of specialized items such as personal hygiene amenities used by the Guest

Billeting division. Purchase orders are initiated when a division makes a request, to the Services Division, for a large quantity purchase of a product. Services Division conducts the transaction with a vendor, requiring delivery of the product to the requesting activity.

The total annual dollar value of the 3000 or so different consumable products purchased with NAF monies is in excess of three million dollars.(CFA Financial Statements FY89)

### **C. REASONS TO CHANGE CURRENT PRACTICES**

In light of the continuing reduction in DOD appropriated funds, budgets in all defense related agencies are being trimmed. Appropriated funds for MWR activities are no exception and the funds needed to make up the shortfalls will have to come from nonappropriated fund accounts. With this in mind, every effort must be made to reduce costs and increase efficiency to ensure that NAF activities get the maximum return on their procurement dollar. The existing procurement system used to purchase non-perishable, high use consumable items may not be the most efficient method and could provide a ripe area for savings.

In the process of determining what might be a more profitable procurement system, one must understand and use some basic underlying principals concerning the activity of purchasing.

Peter Baily and David Farmer, in their book Purchasing Principles and Techniques, provide a description of how an organization can meet it's procurement needs.

Procurement objectives are:

- to supply the organization with a steady flow of materials and services to meet its needs
- to ensure continuity of supply by maintaining effective relationships with existing sources and by developing other sources of supply either as alternatives or to meet emerging or planned needs
- to buy efficiently and wisely, obtaining the best value for every dollar spent
- to manage inventory so as to give the best possible service to users at the lowest cost. (Baily,1978,p.13)

The authors also contend that an efficient materials management system will lower prices for materials and equipment used, reduce transportation costs through collective handling, and reduce duplicated efforts and consequently personnel requirements.(Baily,1978,p.26)

Magnus Rudke states that in the context of economic buying price policies, the following strategies in lowering purchase prices have proved outstandingly successful:

- Purchase price economy through placing larger orders.
- Purchase price economy through a change in supplier on condition that the goods supplied continue to be of the prescribed quality and the new supplier guarantees equal or better compliance with delivery date and service, and that the incidental purchasing costs(transport, packing, etc.) do not eliminate the economy in purchase price.
- Purchase price economy through negotiation with suppliers.(Rudke,1972,p.60)

If activity managers are assured of continuous flow of inventories, if they can depend on fixed delivery dates and know that such dates will be kept, they will be more likely to reduce the quantity and types of consumable products they hold in their local inventory - thus improving their own and the Departments profitability or savings.

By changing some of their procurement procedures, the activities in CFA that are required to operate in a self sustaining business method will be able to earn higher

profits. In addition, once the system is established, all activities purchasing consumable products with NAF money will benefit.

Purchasing items in large quantities from local vendors has the potential for cost savings through economies of bulk transactions. Additional savings may be realized through trade discounts if the vendors realize that they may become sole source suppliers. Increased use of the Self Service Supply Center, the Commissary, the Post Exchange and the US Air Force NAF Purchasing Office's Commander Smart Buy Program as a source of goods and the reduction of BPAs are also expected to result in substantial savings.

#### **D. SUMMARY**

A Services Division Central Warehouse would deal with the physical receipt, storage, consolidation, and issue of consumable material for the purpose of security, control, lower cost through volume buying and efficiency of operations. Building a new warehouse may not be necessary because either the current facility can be used or a no cost facility obtained. Which ever avenue is chosen, cutting the cost of the procurement system requires some investigation to show factual and documented evidence to support the available solutions.

This thesis investigates the costs and benefits of using the present facility, building a new one, or obtaining a facility free of charge. It includes recommendations for optimizing inventory purchasing, storage and management and personnel requirements. The intent is to provide the Assistant Director of Community Family Activities with a sound recommendation regarding the economic gains that may be realized through changes in the current method of procurement. These changes include

warehouse and procurement alternatives that do not require establishing a new warehouse facility.

Chapter two provides the methodology used in the research of this project, including the development of a data base to use in the cost/benefit analysis. The third chapter contains an analysis of the costs associated with changes to the current method of procuring consumable supplies and the resulting potential for savings. The fourth chapter provides recommendations and concluding remarks on how to realize cost savings by making changes to the current system of purchasing standardized consumable products.



## **II. RESEARCH METHODOLOGY AND DATA BASE DEVELOPMENT**

The two topics of this chapter, methodology and data base development, and cost/benefits of standardization set the stage for the rest of the study.

In order to understand the processes used in this study one must first realize the costs and benefits associated with standardization. The first section of this chapter explains not only the costs and benefits of standardization, but also DoD's position on this topic.

The second section, which encompasses methodology and data base development, explains the methods used to study the existing organization and operating procedures as well as an exegesis of how the data base was developed. This section also contains a discussion of findings from interviews, tours and data searches.

### **A. COSTS/BENEFITS OF STANDARDIZATION**

Economics is a science that deals with the production, distribution, and consumption of resources. An effective method of reducing the cost of resources is to limit the variety, and thereby the quantity of those resources. In this study, the resources in question are the consumable products used by the NAF activities. The organized process of determining which of the products will be used as a stock item and getting everyone concerned and involved to adopt them is called 'standardization.'

Both costs and benefits of standardization are often difficult to measure in terms of money and may have intangible value. Cost/benefit analysis is one tool that can

facilitate this process. To make an informed decision on the allocation of resources one must identify the benefits and costs associated with each alternative.

The greatest benefit of standardization is the savings that result from volume discounts, less redundancy and duplication, while the greatest cost is the price of collecting the data necessary to determine and maintain standards.

### **1. Benefits of Standardization**

Many benefits can result from the standardization of products. Robert B. Toth in his book The Economics of Standardization provides a list of benefits.

By minimizing the variety of items, processes, and practices, standardization:

- Improves efficiency in material acquisition
- Conserves money, manpower, time and facilities
- Enhances interchangeability, reliability, safety and maintainability (Toth,1984,p.17)

Mr. Toth also states that benefits are either tangible or intangible. Tangible benefits are those which can be readily measured. They include:

- Greater discounts from larger orders
- Processing fewer purchase orders
- Reducing warehouse operating costs
- Reducing capital investments (Toth,1984,p.17)

Intangible benefits are benefits which can not be readily measured. They include:

- Reducing the need for minor supervisory decisions
- Providing a common language between buyers and sellers
- Improving quality control
- Improving user and customer confidence (Toth,1984,p.18)

Standardization allows for simplification of orders, requisitions, records and goods receiving; it reduces the scope for error; and it often helps by reducing some part of purchasing activities to a routine.(Baily,1978,p.84)

The National Committee on Value Analysis-Standardization provides additional insight into some of the more commonly recognized cost saving features of a good standardization program. Standardization in purchasing and distribution:

- increases flexibility in inventory
- reduces procurement time
- lowers departmental operating costs
- promotes competition among suppliers, encourages lower prices and improved availability
- simplifies paperwork
- promotes delivery schedules and commitments that are more easily maintained.(NAPA,1961,p.4)

A recent Defense Standardization and Specifications Service Program (DSSP) publication describes the benefits for applying standardization and promotes its implementation whenever possible:

Standardization reduces the unnecessary and inefficient proliferation of generally similar types, kinds, sizes and styles of items. Where an existing product or service can adequately do the job it should be used rather than creating a new one. A decision to standardize an existing product saves money, manpower, and time. When a single product (standard item) can perform the job of several other products, replacement of the other products should be considered.(DSSP,1983,p.3)

## **2. Cost of Standardization**

To determine if the standardization of items procured is in the best interest of the organization the costs associated with the standardization must be taken into account. Toth states that costs of standardization are either fixed or variable. Fixed costs are those which do not change based on the number of standardized items procured. Fixed costs include:

- Maintaining a library of standards
- Participating in standardization activities
- Time spent by the standards department training personnel within the agency in standardization and related subjects
- Supervision. (Toth,1984,p.14)

Variable costs are those costs that increase or decrease in a direct way to the number of standardized items procured. These costs include:

- Investment costs: those expenditures associated with standards development
- Implementation costs: this is an expense of initiating the program

- Revision costs : these occur whenever a standard is corrected or updated
- Running cost: time spent interpreting details of a particular standard or advising on applications (Toth,1984,p.15)

### **3. Marginal Costs and Benefits of Standardization**

This study is primarily concerned with the marginal costs and benefits associated with standardization and centralized procurement. Chapter Three discusses the tangible and intangible costs and benefits of establishing a new warehouse facility and compares it to the existing practices. By using this method we are able to determine whether the savings generated by large quantity purchases will outweigh the increased costs associated with the operation of a warehouse facility. By studying all aspects of the current purchasing system and those of a system with a warehouse or distribution facility, one can determine the relative savings before implementation of a potentially costly system.

## **B. METHODOLOGY AND DATA BASE DEVELOPMENT**

The methodology used to determine the costs and benefits of standardizing certain non-perishable consumable products procured with NAF resources, buying them in bulk and distributing them through a warehouse facility, consists of four steps:

1. Background research and interviews
2. Data collection and database formulation
3. Warehouse start up and operating cost estimation
4. Analysis of data

## **1. Background Research and Interviews**

### ***a. Background Research***

Preparation for this study began through research of existing studies of the subject area including information on standardization, warehousing, inventory storage, control and stockage procedures. Warehouse design, size, building and renovation costs and personnel requirements were researched. US Army Morale, Welfare, and Recreation regulations were studied in order to understand current policy and any restrictions that might preclude the use of certain procedures. Following the initial set of interviews, we actively observed the day to day activities of the Services Division and returned for additional interviews to supplement information discovered during the process of building the database. US Army bases that already had existing NAF warehouse facilities were located and managers interviewed. They were also a source of documentation concerning tried and proven procedures used at their facilities.

### ***b. Interviews***

Initial and follow up interviews were conducted with the heads of each separate activity within the divisions that use nonappropriated funding as well as with many people in lower level positions.

Interviews with the personnel actively involved with the purchasing of consumable products and those who provide administrative support were conducted in order to understand their procedures and concerns and to investigate recommendations toward improving the current system. General and specific information developed at the grass roots level enabled us to gain a solid foundation of knowledge not only of how the system is supposed to work, but also how it actually works. A

memorandum providing a brief explanation of the study and the information that would be of interest to us was provided to each interviewee a few days prior to the interview.

The intent of providing the pre-interview memorandum was to encourage the managers and senior personnel involved in purchasing to think about and develop well thought out and informative responses as well as to generate interest in the project by including them from the start. Interviews and visits revealed the following pertinent information.

Of the numerous managers interviewed only a few showed a strong interest in assisting with the study. As a result, the initial impressions indicated that managers were not overly concerned with keeping costs down. This impression could be explained by an apparent apprehension on the part of those being interviewed when they realized that a central procurement and warehouse system would result in a substantial loss in their autonomy to purchase preferred products. This perceived problem and possible solutions will be discussed further in Chapter Four.

None of the activities maintained a Standard Operating Plan (SOP) for ordering items or carrying inventory at the time this study started. Subsequent to the initial interviews however, at least one activity created and implemented a standard plan for procurement and inventory practices. Most of the organizations simply reordered material when the stock level appeared to be low. There is evidence of some general control in all of the activities visited because the managers stated that they have final approval over all BPA purchases. None of the activities maintained historical records of past purchasing activity and could therefore not provide accurate information concerning usage rates.

Tours of the facilities during the interviews revealed varying levels of security and control over the inventories of non-perishable consumable items. There were no common, standard control procedures among the activities.

Although it appeared that specific vendors were used for some products, with few exceptions, virtually all those interviewed claimed no brand loyalty as long as the product chosen for standardization performed acceptably. An exception to the rule concerned product brands that had to be used in order to preclude voiding of servicing contracts, such as those used for automatic dishwashers. The other exception involved specific requests not to use certain brands that were felt to be of inferior quality. The conclusion regarding purchases from vendors who visit the activities for business is that they are used because they are convenient rather than economical.

Several managers stated that they did not like to use the base Self Service Supply Store (SSSC) because it did not maintain a good stock of items, requiring repetitive visits in order to get the quantities desired. As a result, alternative sources are heavily used, with prices more often than not, higher than those at SSSC. There were also complaints concerning the quality of the merchandise available through the store. These observations, and the fact that purchases from SSSC require someone to visit the facility, tend to support the hypothesis that BPAs with vendors who actively farm an activity and deliver the purchased products are used as a matter of convenience. At the opposite extreme, some managers try to use SSSC as a sole source and claim success, for the most part, with few complaints.

Several senior managers within the divisions voiced a concern that unless they were explicit in the definition of their requirements, they would receive an



unacceptable product when they attempted to use Services division to make purchases through the contract and bidding method of procurement. This, and the longer lead times necessary for purchasing methods other than BPAs further supports the tendency to use vendors because the people making the purchases know exactly which products they will receive when an order is placed.

Some of the activities use petty cash to make small purchases of administrative and general merchandise from merchants in the local community. The managers who used this practice stated that they were aware of the probable higher cost of purchasing those items at retail prices from local stores. They felt that the total cost of these purchases was so minute in comparison to their overall budgets, that it did not warrant any real effort in finding a cheaper price.

A prevailing theme during all interviews was the importance of the right quality of goods purchased. The managers of the activities who will make up the customer base for a warehouse system were emphatic that high quality products are chosen as the standard items. Of equal importance was the contention that a warehouse facility had to be customer orientated and managed by a competent individual dedicated to providing top quality service.

Important differences in material requirements from the base year used for gathering the cost data also surfaced. The clubs are to lose their cleaning service contracts which had previously provided all lavatory and common area cleaning products. In addition, several new facilities are to come on line over the next year. Another potential problem with the information used for the data base was revealed when one activity manager explained how he had stocked their storerooms

with consumable products purchased with appropriated funds at the end of the year prior to the year used for the database. It was their last opportunity to purchase the type of products used in this study with appropriated money.

Various personnel within the Financial Management and Services Divisions were also interviewed. These interviews provided information on the present ordering and bill paying procedures and the effect a warehouse system would have on any of these operations.

Purchasing agents within the Services Division pointed out that the consolidation of purchases would streamline procurement procedures because the number of individual purchases would be reduced drastically. This contention was echoed by members of the Central Accounting Office who added that the number of receiving reports processed would be reduced and current problems with timely receipt of documentation would be alleviated.

## **2. Data Collection and Database Formulation**

The NAF activities buy literally thousands of items. These items range from food to office supplies. Time and resource constraints restrict this study to non-perishable repetitive use items that might be standardized, purchased, stocked, and issued through a central warehouse facility. These items were selected by inspecting all procurement receipts for NAF funds by all activities for fiscal year 1989<sup>4</sup>. This data was supplemented by interviews and records maintained by the Central Accounting Office.

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<sup>4</sup>Throughout this thesis, unless otherwise specified, the term "FY89" refers to the fiscal year 1989 which extended from Oct 1, 1988 through September 30, 1989.

Most of the purchasing data was maintained by the Services division and thus was available at a single location. Services Division had also attempted to solicit information from the activities to build its own database of commonly purchased items. Receipts for items procured from the base Self Service Supply Store were not maintained by the Services division but were available through the automated billing system used by SSSC.

Dbase 4<sup>5</sup> was chosen as the software package for data storage and manipulation. The information collected consisted of the following:

- Date of the purchase
- Activity making the purchase
- Vendor
- Unit size
- Quantity purchased
- Unit price
- Total price

After the initial data collection, several iterations of adjusting the data were required to consolidate the multiple brands of similar products into one generic product that could be used as a standardized item. In order to ensure that products were properly classified as to their purpose and usefulness, follow up interviews were conducted with the activities and vendor listing sheets were reviewed for product

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<sup>5</sup>dBase 4 is a registered trade mark of Aston - Tate, Inc.

descriptions. All of the quantity, container size and price information had to be adjusted to a common base for each type of product.

Monthly, quarterly and annual usage factors were then calculated for each product type to eliminate those products that were either not commonly used or used at such a slow rate that they did not warrant further examination. The criteria for product selection will be discussed in detail in the following chapter. Finally, description of purpose and brand names were used in soliciting cost data from potential suppliers. The prices provided by the various sources of the products, were the final field of information in the database. A detailed listing of the standardized products used in this analysis is provided in Appendix A.

Problems encountered during the formulation of the database included:

- Hand written receipts that were often illegible and contained terminology peculiar to each vendor.
- Several filing systems contained unique information as well as repetition of information from other sources. This required disaggregation of some files in order to retrieve specific data necessary for a complete data base.
- The type and quantity of consumable products purchased with petty cash could not be identified.
- The myriad of products on the market which are often used for multiple and different purposes by each activity posed the biggest difficulty because they had to be consolidated into one type of product that was satisfactory to all.

The FY89 quantities and total cost in the data base for each product are not exact figures. The totals developed from the data base are not materially less than what was actually purchased in FY89, but deserve comment. Numerous reasons exist that contribute to this situation, among them are the following:

- The original source data consisted mostly of handwritten receipts. A small portion were illegible and not entered into the data base.
- The data was not maintained in a single filing system. This required cross checks of numerous files and may have resulted in some information not being discovered.
- During the interviews, several activities stated that they made purchases using petty cash. These purchases could not be quantified and were also left out of the data base.
- The interviews also revealed that at least one activity had stocked its consumable supply storeroom with many of the products we were interested in at the end of FY88. This was done because appropriated funds could be used to purchase these items until the end of FY88 and the manager knew this stockpiling would save costs in FY89. The result of these four procedures is some measure of inaccuracy in the data base because smaller than actual usage rates and costs were recorded while developing the data base.

On the other hand, the quantities of specific products expected to be purchased in the future are materially more than the quantities of standardized products used in this study. It can be expected that future spending on these products will increase because of two primary reasons.

- A new higher capacity child care facility is under construction. The child care manager stated products will be used at a rate of 2.5 times previous year quantities.<sup>6</sup>
- A second change is the cancellation of the cleaning contracts for the club facilities. As noted previously, the Janitorial Company contracted to provide cleaning services had been supplying all lavatory products. No activity manager knew how much of an increase to anticipate and the contractor would not provide any information on past usage.

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<sup>6</sup>Personal conversation between Lt. Strei and Ms. Edwards, Child Development Services, 22 February 1990.

These problems result in this study being an estimate rather than a precise finding of savings to be expected. The above mentioned factors contribute to lower usage rates, thus the estimated savings in this report will be the least that can be expected. Once better record keeping is instituted and future changes have occurred more exact figures can be determined.

### **3. Warehouse Start Up and Operating Cost Estimation**

Chorafas describes 'warehousing' as the physical process of materials handling and holding and the methodology underlying this process. It is the storage and retrieval of goods. He further states that there are six major elements that constitute the throughput activities of the typical warehouse: transfer, receiving, storage, handling, expediting and packing.(Chorafas,1974,p.6)

The carrying cost of warehouse inventories must also be taken into account. Costs that are relevant to the proposed type of inventory to be carried include interest for the use of money invested in the inventory, freight costs to get the inventory to the warehouse and the cost of loss and damage. These cost elements will be examined in detail in the next chapter when the cost of each of the warehousing activities are incorporated into the cost/benefit analysis.

The warehouse building is distinct from the process of warehousing and has its own costs that must be examined. These costs include the cost of building a new structure or renovating an existing one, utility costs and upkeep costs. The size of the structure will depend on its intended contents which, in turn, will be determined by the monetary savings that carrying that inventory will yield. Chorafus also contends that a budgetary study for a new warehousing facility must concentrate in a factual and

documented way on initial investment, return-on-investment and operating costs. These costs are analyzed and incorporated in the cost/benefit analysis in the next chapter.

#### **4. Analysis of Data**

Chapter Three provides an in depth analysis of all of the data collected and applies cost/benefit methodology to determine if it is economically justifiable to build and operate a warehouse. The essential elements of the analysis consist of a comparison of the projected savings through large quantity purchases of standardized items with the cost of establishing and operating a warehouse facility.

#### **C. SUMMARY**

The two sections of this chapter provide a broad perspective from which to understand this study. The section covering the costs and benefits of standardization shows that it is possible to perform a cost/benefit analysis on the standardization of items and centralized purchasing. The final section describing the methodology used, shows a logical, orderly process was used to develop and analyze the information needed to make a sound recommendation.

### **III. COST/BENEFIT ANALYSIS**

The recording of effective reductions in buying prices is essential in directing and observing a systematic price reduction campaign. The effects of savings in buying, and the effects of purchase cost decreases, must be identified individually and cumulatively.(Rudke,1972,p.61)

With this concept in mind, Chapter III begins with an explanation of which non-perishable consumable products were chosen to be standardized, analyzes and compares the costs paid in FY89 with those that would be paid if consolidated purchases of standardized products were made, and concludes with an analysis of the cost differences. The model developed for this study is a mathematical comparison of costs versus savings. As will be noted in the following discussion of costs, the conservative path has been taken in each case. This choice was made in order to ensure that decisions based on this study are not determined by overly optimistic results.

#### **A. PRODUCT STANDARDIZATION**

Because the variety of products purchased on a routine basis by NAF activities number in the thousands, the cost of a warehouse system large enough to handle all of these items would be huge. This study therefore is limited to those items which are common to many activities and are purchased in large enough quantities to warrant examination for savings through quantity purchases.



In the process of compiling the data base, certain products showed up at systematic intervals which, upon investigation, coincided with routine, scheduled purchases by various activities. Other items, although not necessarily purchased systematically, showed up enough times to capture the attention of the researchers. These two groups of products were intentionally isolated during successive manipulations of the data base and became the standardized products used for this study. All products in the original data base that were used by activities for the same essential purpose were then consolidated under generic product types. Quantities and costs were adjusted as necessary for standardization of these two fields.

The cost analysis in the next section uses the lowest price of each product in the final database to force the outcome to reflect the maximum in savings if the cheapest product were always chosen. The model does not reflect a concern discussed by Baily that should be considered when an activity is in the process of standardizing products.

Prices after standardization were not in all instances as low as the lowest price which any user paid before standardization. In some instances, the price after standardization may well be substantially lower. But speaking generally, it does not pay to standardize on the cheapest. When a local authority or a business has been using dozens of different versions of any article for substantially the same application, we may expect to find that some of the versions were too good for the application, and therefore cost more than they were worth to the user, while others were not good enough for the job. The problem in standardizing is to standardize, not on the cheapest or on the dearest, but on the right quality for the particular application.(Baily,1978,p.85)

## **B. COST ANALYSIS**

This section uses a step by step procedure to compare the costs that were paid using the BPA system that is in effect now with the costs that would be incurred if a warehouse were built and operated with an inventory of standardized products.

### **1. Non-perishable Consumable Item Cost: FY89 Versus the Present**

The price paid and quantity purchased in each separate order in FY89 for each of the standardized products used in this analysis has been entered in the data base and added together in order to determine the total amount spent. This total will be used as a base cost for comparison with the price that this study determines would have been paid for the same quantities using a centralized purchasing system with a warehouse. Increases or decreases in the variety of products carried as inventory will require adjustments to the model accordingly. In FY89, a total of \$119,755.96 was spent on the goods evaluated in this study. Appendix A provides the detailed cost calculations of purchases made in FY89. Because this dollar value is to be compared with prices in 1990, it requires adjustment for inflation. The United States Department of Labor Consumer Price Index Detailed Report for January 1990 revealed a 5.6% change in housekeeping supplies for urban consumers from January 1989 to January 1990. This results in an adjusted price of:

$$\text{\$ } 119,755.96 \times 1.056 = \text{\$ } 126,462.29$$

The cost of the standardized items in 1990 dollars was determined by recording demand and surveying local vendors for availability and price. Price requests were sent to fourteen vendors, including SSSC and the Commissary; eight of those

potential sources replied. The replies were then validated to ensure the products they offered were comparable to those in the data base and the lowest cost supplier of a product was chosen to represent the provider of future demand. Appendix B contains the material cost per year in 1990 dollars for the standardized products. Summation of the annual cost of the standardized items results in a total cost of \$85,416.14.

A savings of 32.5% in material cost, with a dollar value of \$41,046.15, could be realized using the assumption that the purchases made in FY89 would be repeated in 1990 as is done in this calculation.

$$\text{\$ } 126,462.29 \quad - \quad \text{\$ } 85,416.14 \quad = \quad \text{\$ } 41,046.15$$

## **2. Costs Related Directly to a Warehouse Facility**

There are numerous costs associated with the establishment and operation of a warehouse facility. The idealized warehouse used in this study is a simplified, small scale storage facility that houses a limited number of items. It is assumed that Services Division will either request that a warehouse be built or acquire a building that can be easily converted to function as one. In either case, it is assumed that the land the edifice rests on will be obtained free of charge. A seven thousand square foot building will provide enough space to carry the inventory quantities expected and is used in the calculations for this analysis.

The costs discussed below were obtained from either published standards or calculated using the cost-estimating method of analogy. Where standards were not available, estimating by analogy was used because the data did not lend itself to statistical methods. In using the costs developed through analogy for this model, one

should consider that analogy is only useful for rough estimates. The major drawback to estimating by analogy is that it is essentially a judgement process and, as a consequence, requires considerable experience and expertise to be done successfully. (Batchelder,1969,p.7)

**a. Cost to Erect a New Facility**

A warehouse built to house the products considered in this study should be of very simple design and construction.

Galvanized, corrugated sheet steel buildings are generally the most economical to build. The material is relatively low-priced and application costs are lower than for many other types of construction. The availability of this type of material and the speed at which a building made of it can be erected make it desirable for some warehousing uses.(Jenkins,1968,p.58)

Because the depth of this study does not permit a detailed analysis of the specific costs associated with the construction of a warehouse building, an established standard, Means New Construction Guide is used to calculate a warehouse construction cost of \$217,700.00.

The median price to build a warehouse and office combination is \$31.10 per square foot.(Means,p.366)

$\$ 31.10 / \text{SF.} \times 7000 \text{ SF.} = \$ 217,700.00$

**b. Warehouse Labor Requirements and Cost**

Two personnel would be required to operate a warehouse of the size being considered; a warehouse manager and a warehouse worker.

The manager would be responsible for daily operation of the warehouse facility including maintaining inventory at an economic level while at the same time ensuring customer satisfaction. In conjunction with an assigned contracting officer, the manager would be responsible for ordering products, providing for their delivery to the warehouse site and subsequent distribution through customer pickup or delivery.

The major duties of a warehouse worker would encompass receiving and picking up supplies, checking quantities against shipping documents and reporting any irregularities. He would store the items manually with the assistance of hand operated handling equipment and issue or deliver supplies as required. He would also be required to post receipts and issues to stock record cards through an established computer software program and generally assist the manager as requested.

This analysis assumes that the warehouse managers' grade will be NA-5 while the workers' grade will be NA-4. In both cases, the middle step in each grade is used and it is assumed that both individuals will elect all available benefits. The benefit package requires an addition of twenty percent of the annual earnings to the annual cost of each employee.<sup>7</sup> In accordance with the DoD Wage Fixing Authority Wage Schedule 001 dated 18 May 1989, the median hourly wage rate for the manager will be \$6.55 per hour and \$6.24 per hour for the worker. A forty hour work week is used which equates to 2,080 hours per year.

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<sup>7</sup>Personal conversation between Lt. Strei and Ms. Linda Morello, Resource Management Division, 16 April 1990.

<u>Grade</u>	<u>\$/hr</u>	<u>hr/yr</u>	<u>Benefits adjustment</u>		<u>Total \$ /yr</u>
NA-4	\$ 6.24	X 2080	X	1.20 %	= \$ 15,575.04
NA-5	\$ 6.55	X 2080	X	1.20 %	= <u>\$ 16,348.80</u>
Total Labor cost per year:					= \$ 31,923.84

*c. Building Utilities and Maintenance Costs*

The Services division or its parent department will be required to pay for the utilities used in a warehouse as well as upkeep of the building. Electricity and water will be used; combined, they will be a minimal expense. Electricity costs have been calculated with information provided by the Energy Management Division of the base Department of Engineering and Housing. Water is expected to be used for an on site lavatory as well as to mix products that may be purchased as concentrates. The quantity that would be used is unknown, however a cost of two hundred dollars per year is used for illustrative purposes. It is assumed that the hours the facility will be occupied and in use is 2016 hours per year with the cost of one kilowatt(kwh) of power set at .078 cents.

Elec power use : 3580 wathrs X 2016 workhrs = 7217 kwh

Elec power cost: 7217 kwh X \$0.078 / kwh = \$ 562.00

Water cost: + \$ 200.00

Total utility cost per year: \$ 762.00

Use of the warehouse building itself will require routine maintenance which will include items such as cleaning material, light bulbs and fixtures. Therefore,

operating expenses must also be accounted for. Because of the paucity of information available that can be directly applied or adjusted to reflect the true operating expenses of an activity such as this proposed warehouse, this study uses a plugged figure to reflect this expense. In view of the recommended simplicity of this operation, operating expenses are assumed to be minimal. Therefore an expense of \$500.00 per year is used.

*d. Storage, Handling and Distribution Requirements and Cost*

The appropriate selection of material handling equipment and the system of commodity storage can play a major role in controlling warehouse costs. Therefore simplicity should be the rule. The storage system should use pallet racks and shelves or bins. Handling equipment can consist of pallet lift jacks, platform trucks and hand trucks. This model assumes that all of these items can be procured free of charge through the Defense Reutilization and Disposal System. DOD Directive 4160.21-M. provides guidance and procedures for obtaining the items required.

One of the main objectives of an effective distribution plan is to attain the lowest cost for the movement of goods. In the current system, activity managers appear to meet this objective by requiring that vendors deliver the products purchased. In reality however, the distribution costs incurred by the vendors is passed on to the customers through the pricing of the product.

This study assumes that standardized consumable items will be delivered to a NAF warehouse with the above mentioned cost of delivery accepted as a part of doing business. However, since purchases from vendors will be in larger

quantities, the number of deliveries will be reduced. The decrease in the number of deliveries should be reflected by lower prices for large quantity purchases. Those products purchased from SSSC or the commissary however, will require pickup from those sources. The labor involved in picking up orders from these two sources would be part of a warehouse laborers job and as such is included in the cost of the warehouse labor calculated above.

Distribution from the warehouse to customer activities can be accomplished through two methods. In the first method, the activity would provide the labor and transportation to pick up their purchases. This is a viable alternative in that most activities currently make some purchases from SSSC and the commissary and in both cases are required to pickup their purchases. In addition, the time spent inside both SSSC and the commissary would be eliminated since their requirements could be called in to the warehouse for pre-pickup assembly. This method would result in no cost to the warehouse organization for distribution. The second method would consist of a delivery system run by the warehouse. Assuming that the labor is accounted for as in the first method, the other cost for distribution is transportation. Services Division currently has a vehicle assigned to them for use in support of their established warehouse. The following expenses have been budgeted for operating the vehicle and will be used in this study since the cost of operating the vehicle will have to be assigned to the warehouse operation.



Maintenance Expense/yr:	=	\$ 300.00
Operating Expense/yr:	=	\$ <u>500.00</u>
Total annual cost for distribution transportation:		\$ 800.00

*e. Inventory - Ordering and Holding Costs and Order Quantity*

The cost of the material used annually was calculated in the first part of this section but that discussion did not consider the quantity of a product purchased in each order. Ordering and Holding costs are directly related to the amount of inventory carried in a warehouse.

This study presumes that the economic order quantity (EOQ) of the standardized items will be ordered. EOQ is the amount of inventory to be ordered at one time for purposes of minimizing annual inventory cost. If any activity purchases in large quantities, the cost of carrying the inventory is high because of the sizeable investment. If purchases are made in small quantities, frequent orders with comparatively high ordering costs will result. Ordering costs include the clerical work and supplies that are associated with placing an order. It also includes the cost of inspecting and paying for the order and is independent of the size of the order. Holding cost is the cost of keeping inventory for future use. The cost to hold includes the charge for investment of capital, storage costs, losses due to obsolescence and pilferage, and shrinkage as a result of loss and damage. Storage costs consist of the following expenses: care of material in storage, re-warehousing costs, cost of physical inventory operations, training of storage personnel and maintenance of warehouse equipment. Because this is a federal activity, there are no insurance or tax costs involved.

A modern day warehouse facility will normally use a computerized inventory management system to manage inventory stock level. NAF Services Division currently has a sufficient number of micro computers to assign one to a warehouse facility. In addition, software that might be used for a system of this type is already in use by the division. Therefore, the cost of an automated inventory management system is not included in this assessment.

In order to reduce the time consuming data manipulations involved in determining ordering and holding costs, the computer software program Quantitative Systems for Business Plus (QSB+) is used to calculate the required information. This program enables evaluation and prediction of Economic Order Quantities(EOQ) and EOQ with discount analysis. EOQ is that quantity which when ordered will minimize total cost. The head of the Service Division has stated that he would restrict order quantities and inventory levels so that they do not exceed the quarterly usage rates for the various products. As will be shown later, the cost difference between EOQ and the service manager's desires are not significant and unless otherwise noted, the examples in the following sections reflect the costs associated with EOQ. The data required by QSB+, are demand, order cost, holding cost (as a percent of unit cost), shortage cost, replenishment rate, lead time and unit cost. To analyze discounts, discounts and price breaks are also required.

No shortages were assumed, which results in no shortage cost, and lead time was assumed to be zero. These assumptions are unrealistic but are concerned with the amount of safety stock to maintain and as such are not within the scope of

this study. Since several of the standardized products are used in large quantity lots for non-routine functions such as club activities, it would be imperative that no shortages of those products occur.

(1) Ordering Costs. NAF managers had no information available concerning the cost of placing an order through a BPA. Correspondence with the Naval Supply Systems Command revealed that the Navy had collected this information for several commands on the west coast. Naval Supply Center San Diego and Puget Sound had experienced costs of \$15.03 and \$14.84 respectively for FY89. This study assumes that NAF BPA purchasing costs would be approximately the same regardless of the military service, but to ensure that the cost is not underestimated, the ordering cost used in the calculations is \$16.00. The QSB+ calculations for determining the ordering cost for a year in Appendix B are based on the following equation:

ORDER COST =  $K (D/Q)$  where:

K = the cost of placing one order

D = demand in one year

Q = the EOQ

Using the above formula and the information for bleach from Appendix B as an example, the ordering cost is calculated as follows:

$$\text{\$ } 16.00 \times (3495 / 927.52) = \text{\$ } 60.28$$

For the standardized items used in this study, the total ordering cost for a year at the listed demands is \$2,471.66. To determine the ordering cost of

these same items for FY89, the cost of placing an order and the number of orders placed during FY89 are multiplied.

$$\text{\$ 16.00 / order} \times 1329 \text{ orders} = \text{\$ 21,264.}$$

Theoretically the savings associated with centralized purchasing would merely be the difference between these two ordering costs, or \$18,488.34. But this assumes a reduction in the factors that constitute ordering costs. Of the costs associated with placing an order, labor is by far the most expensive input. In order to realize this savings, labor costs would have to be reduced. Interviews showed the activities usually had one or two people involved in the ordering process. This was either the activity manager or his assistant and in all cases the process of ordering was a minimum drain on their time. When asked if a centralized purchasing center would reduce the work load enough to eliminate a position or reduce a positions work hours all replies were negative.

Under the present system, most of the vendors visit the activities weekly and ask if any orders are needed. The managers then rely on the knowledge they have of their inventory and of future demand before deciding to place an order. The present system places most of the cost of ordering on the vendors.

Eliminating labor as a possible area for savings in ordering leaves only the supplies used as an area of savings. These savings are not significant. Therefore, the current system and a centralized purchasing facility are considered to have the same ordering costs.

(2) *Holding Costs.* The measurement of inventory carrying, or holding cost looms as a formidable challenge to standards managers. Accountants and inventory control specialists have developed a widely accepted technique for accommodating all of the variables. They establish an annual inventory carrying cost which is based on the total of the costs associated with carrying the items in stock. This typically ranges from 15 to 25 % of the value of the stock and simplifies the task of analyzing the effects of standardization actions.

The investment charge for cost of capital is 10% which represents the average rate of return on private investment.<sup>8</sup> In accordance with OPNAVINST 4440.23, (Procurement cycles and safety levels of supply for secondary items) the cost of storage factor is 1%. Because the items considered are generic repetitive use items that will be consumed quickly, no cost for obsolescence is included. No specific guidance was available from local sources concerning the rates to use for pilferage and shrinkage, however conversations with knowledgeable people in this area indicates that the following rates would be considered average. Pilferage is estimated to cost 3% and shrinkage 2%. The total holding cost for carrying each unit of inventory is therefore 16% of the price of each of the stocked items.

QSB+ assumes that all inventory cycles are of equal length and the inventory is depleted uniformly. Therefore, the average inventory over time is  $Q/2$ ,

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<sup>8</sup>Office of Management and Budget Circular No. A-94, Discount Rates to be Used in Evaluating Time-Distributed Costs and Benefits.

where Q is the EOQ. In order to determine the holding cost for a year the following formula is used by QSB+:

Total holding cost =  $h(Q/2)$ , where

$h$  = holding cost per unit per year (16% of unit cost)

$Q$  = EOQ

Again, using bleach as an example,

$$16\% \times \$ 0.79 = \$ 0.13$$

$$Q = 927.528$$

$$\text{Total holding cost for a year: } .13 \times (927.52/2) = \$ 60.28$$

The EOQ analysis for all of the standardized products results in a total holding cost of \$2,333.32 for the annual quantity of goods expected to be carried in a warehouse. Since products purchased in FY89 were purchased directly from a vendor rather than issued from a warehouse, there is no associated cost for that year.

In summary, a comparison of total costs for purchasing and carrying an inventory based on ordering at the EOQ versus the quarterly usage rate reveals a difference of \$2744.15 between the two methods. As stated previously, the ordering cost involved in purchasing the inventory is assumed to be the cost calculated for FY89.

	EOQ	QTRLY
Order cost	= \$ 20,960.00	\$ 20,960.00
Holding cost	= \$ 2,333.32	\$ 1,537.85
Material cost	= \$ 81,725.45	\$ 82,155.60
Total cost	= \$ 105,018.77	\$ 104,653.45

The difference between the EOQ and quarterly purchase quantities is calculated as follows:

$$\text{\$ } 105,018.77 - \text{\$ } 104,653.45 = \text{\$ } 365.32$$

*f. Miscellaneous Costs*

There are several other expenses associated with standardizing and establishing a centralized procurement operation which should be addressed. For the most part, they are tangible but not easy to measure.

The primary expenses that are difficult to account for are associated with the process of standardizing. Participation in maintaining a library of standards, standardization activity such as training, and supervision, can really only be measured as an opportunity costs. The employees involved are already being paid to do assigned tasks; the addition of tasking associated with standardization means they are not performing the job they would normally be doing at that time. These investment costs, the expenditures associated with standards development are not given a monetary value in this study because it is assumed that the addition of this tasking will not impact other work significantly. In any case, they should be identified as fixed costs since they will exist regardless of how many items are standardized.

Likewise, implementation, revision and running costs are difficult to quantify. Revision costs occur whenever a standard is corrected or updated while running cost is the expense associated with interpreting details of a particular standard or advising on applications.

### C. SUMMARY

In order to determine if it is economically justifiable to build a warehouse, the annual costs associated with operating the facility must be compared with the annual savings that would be generated by purchasing standardized products and distributing them through a warehouse system, in economic order quantities.

<u>Expense Item</u>	<u>Dollar Value</u>
Utilities:	\$ 762.00
Operating expense:	\$ 500.00
Labor:	\$ 31,923.84
Distribution:	\$ 800.00
Holding costs:	\$ <u>2,333.32</u>
Total annual operating cost:	\$ 36,319.16

The savings that would be generated in one year can be calculate by subtracting the above cost of doing business from the savings that could be realized from EOQ purchasing of standardized products.



Annual savings in material cost:       \$ 41,046.15  
 Total annual operating cost:       - \$ 36,319.16  
 Total expected annual savings:       \$ 4,726.99

The expected annual savings of \$4,726.99 must be compared to the cost of building a warehouse, which is \$217,700.00. For purposes of this study, the amount of savings is considered to be an annuity. The present value (PV) of that annuity is then compared to the cost of building the warehouse. The warehouse is initially assumed to have a total useful life of 30 years, hence, the annuity will run for that length of time as well.

Because of the uncertainty of both the cost of capital and the service life of the building, the following sensitivity analysis is provided in order to address a shorter service life as well as three different rates of interest. A service life of five years is chosen to illustrate the outcome should the military base this NAF activity supports, be shut down. The present value of the savings over 30 years is calculated as follows:

<u>Interest Rate(%)</u>	<u>PV factor</u>	<u>Savings</u>	<u>PV of savings</u>
8	11.258	X \$ 4726.99	= \$ 53,216.45
10	9.427	X \$ 4726.99	= \$ 44,561.33
12	8.055	X \$ 4726.99	= \$ 38,075.90

The present value of the savings over 5 years is calculated as follows:

<u>Interest Rate(%)</u>	<u>PV factor</u>	<u>Savings</u>	<u>PV of savings</u>
8	3.993	X \$ 4726.99	= \$ 18,874.87
10	3.791	X \$ 4726.99	= \$ 17,920.01
12	3.605	X \$ 4726.99	= \$ 17,040.79

As can be seen, even the most optimistic outcome does not provide enough savings to recoup the cost of building the warehouse. These calculations do not take into account any increases or decreases in expenses or quantity of material that would reasonably be expected to occur.

The following calculation shows that in order for the warehouse to be built at even a break even cost, \$19,354.55 in savings would have to be generated on an annual basis over 30 years. The computation assumes an 8% interest rate with a PV factor of 11.248.

$$\text{\$ 217,700.00} / 11.248 = \text{\$ 19,354.55}$$

This chapter has provided a step by step analysis of costs and savings associated with building a warehouse, standardizing non-perishable consumable products, and distributing them. It proves beyond a reasonable doubt that because of the relatively few number of items that might be standardized and the low volume of these purchases, that building and operating a warehouse facility is not economically wise.

Inclusion of perishable items, primarily food stuffs, soft drinks and alcoholic beverages, might increase the volume of material distributed through a warehouse to

that level necessary to realize a savings. The additional expense of carrying these items however, would have to be offset by substantial savings in order for it to be a prudent path to follow.

There are numerous alternatives, other than building a warehouse facility, that will generate savings and should be investigated. The next chapter will discuss several of these options and provide several avenues of study.

## **VI. RECOMMENDATIONS AND CONCLUSIONS**

The most important factor involved in organizing an effective standardization program is the attitude and expressed desire of top management to support the program as an organized departmental activity. This study is the first step in implementing such a program.

Sensible economy in purchasing standardized products demands initiative on the part of buying departments. Proficiency in the skill of buying, a wide knowledge of the market, clear planning to ensure a particular result, and 'know how' are essential to achieving success. Permanent and extensive lowering of purchase costs is the outcome of a coherent system of practical buying.

By analyzing the effect of eliminating the costs calculated in the previous chapter, numerous alternatives to the present system of purchasing consumable products can be developed. Regardless of which method of procurement is used to purchase these products, several additional areas of standardization should be investigated in order to realize still further savings.

### **A. Alternatives to the Warehouse Cost Model**

Three deviations to the model developed in the previous chapter will illustrate the vast number of alternatives available to the manager who truly wants to cut costs.

## **1. No Cost to Build Warehouse**

If an existing warehouse edifice is obtained free of charge or a new warehouse is built with appropriated funds or donations, then the potential for savings becomes far more obvious. Using the quantities computed in the previous chapter, the total cost of operating a warehouse was determined to be \$36,321.54 while the savings generated from purchasing inventory at EOQ was \$40,075.32. The difference between these two numbers is the savings generated over a year, \$3,753.78. Although relatively insignificant at this point, if one considers that conservative values were used in the computations, then the potential for larger savings becomes more evident. With some investigation and ingenuity, other products could be found that would lend themselves to standardization and or procurement in large quantities.

There may be opportunity cost involved in using an existing building for a warehouse facility or using appropriated funds to build one. Before an existing structure is converted to function as a warehouse, managers should consider alternatives that may prove more profitable. Although a building built with appropriated money would not be an expense for CFA, it would still be a cost to the government. The opportunity cost of the money appropriated from the MWR fund should be considered.

## **2. No Additional Laborers Hired**

If the cost of labor is removed from the total cost of operating a warehouse, the savings increases to \$36,650.83

$$\text{\$ } 41,046.15 - (\text{\$ } 36,319.16 - \text{\$ } 31,923.84) = \text{\$ } 36,650.83$$

This assumes the labor to operate the warehouse can be obtained by a reorganization of current personnel. If this savings is also treated as an annuity, then it takes approximately 10 years to break even on the construction cost of a warehouse if the cost of capital is 10% and the warehouse cost is the same as stated previously. Over 30 years the present value of the annual savings is:

<u>Cost of Capital(%)</u>	<u>PV factor</u>	<u>Savings</u>	<u>PV of savings</u>
10	11.258	X \$ 36,650.83	= \$ 412,615.04

If one considers the cost of personnel currently drawing from the NAF payroll as essentially sunken costs, then changes in the current personnel organization could provide the labor necessary to operate a warehouse. The opportunity cost of shifting personnel should be investigated to ensure that changes benefit the organization as a whole, rather than parochial interests. The above computation illustrates that many alternatives for staffing a warehouse facility are available and only require some investigative work to optimize.

### **3. No Cost to Build Warehouse or Increase in Labor**

If a warehouse can be obtained free of charge and sufficient personnel assigned without significant increases in payroll costs, then virtually all of the savings generated through standardization and volume purchasing, may be realized. This alternative is the least likely to occur, however, it generates more possibilities to recognize savings through standardization.

## **B. ALTERNATIVES TO ESTABLISHING A FULL SCALE WAREHOUSE**

There are countless alternatives to the present system of procuring high usage consumable products. The following sections describe several of those options.

### **1. Centralized Procurement**

An alternative to establishing a full scale warehouse that still retains the benefits involved in purchasing large quantity lots of products, involves a centralized procurement system. When all activities involved can agree upon a significant number of products to standardize, a database of these products could be established at Services Division. Monthly or quarterly requirements of each activity would be called in or simply delivered via formatted computer discs. These requirements would be consolidated and placed out for bid with the vendor offering the lowest price winning that contract. Such a system could even involve a requirement in the contract that the product be delivered to several locations. Although this would increase the price somewhat, it would resolve the distribution problem.

### **2. Receiving and Distribution**

Another option would be a system which is operated essentially the same as the one just described, but includes a receiving and distribution facility. In designing a distribution facility, management must anticipate the needs of its customers and estimate the costs to satisfy them.

A section of the current Services Division building or some other easily obtainable facility, could be modified for this purpose. Rather than stocking any items, this facility would simply receive the large quantity deliveries and immediately

distribute them to customer activities with Transfer Between Activity (TBA) receipts. Although a system of this type would require that each activity carry their own stock, all of the activities visited had enough available storage area to carry their own inventory. The savings made from purchasing in large quantities would have to be measured against the cost of carrying that inventory. With proper management, inventory would be kept to the minimum required to carry out their activity properly.

Storage and handling cost would be minimal and the manual labor necessary in a system of this type is relatively cheap. Both the ordering and TBA could be handled through a relatively simple computer software program. Once such a program is established, the level of skill necessary to enter data is minimal. A safety stock could be kept at Services Division to ensure that no shortages occur.

### **C. ADDITIONAL RECOMMENDATIONS TOWARD COST SAVINGS**

#### **1. Sources of Standardized Products**

The Self Service Supply Store and the commissary are two examples of sources of consumable supplies other than local commercial vendors. Memorandums of agreement should be drawn up with both activities that arrange for them to make the large quantity purchases of consumable goods used by NAF activities. Services Division could then arrange for distribution or pickup by the customer activities.

#### **2. Restrictions in Purchasing**

Savings can be realized through further limitations in the use of BPAs. BPAs are extremely useful for short notice purchasing and are very convenient when



a vendor also delivers what the activities purchase. Both aspects are usually reflected in the price of the product. With minimal planning, short notice purchases can all but be eliminated. The fact that all activities involved in this study purchased their consumables from both SSSC and local vendors, indicates that they in fact do have time to shop at SSSC or the Commissary. As long as arrangements or plans are made to ensure that enough of the desired products will be on hand or available, there should be no reason not to buy consumable products from those sources.

Some BPAs should be maintained to ensure that there is always a ready source available when the normal source is not. Restrictions on exactly which products are allowed to be purchased from certain vendors or merchants will also result in savings. For instance, assuming SSSC has the cheapest price, there is no reason why an activity should go out to a stationary store to buy pencils because they ran out. On the other hand, SSSC may not carry Guest Checks, in which case, there is no alternative but to purchase them through a BPA.

### **3. Standardized Procedures**

As previously mentioned, no activity had a set of standard operating procedures. Although possible, it is unlikely that each activity is procuring consumable supplies in the most economical fashion. By first determining the best method and then establishing a set of standardized procedures, each activity would benefit and there would be a stronger tendency to work as a group rather than as separate business activities.

Standards for stock security should also be established. Some activities have anti-pilferage measures in effect while others did not. Although the majority of employees are probably honest, it only takes a few dishonest people taking small quantities of items over a long period, to create a constant draw.

#### **4. Other Savings**

Several other cost saving measures mentioned in this section are concerned with standardizing operating equipment. By standardizing the equipment, the supplies used in them become standardized as well.

For example, why not lease all the same type of copier machines? The paper, toner and developer used in them would then all become standard and candidates for large lot purchases.

Adding machines and typewriters or printers would also lend themselves to this procedure. By enacting regulations now concerning the types of products to purchase, over time, as old equipment wears out the new would become part of a standardized base, thus limiting the variety of support items used by the equipment.

Another avenue towards savings that warrants further investigation concerns the replacement of products with ones that provide the same service, but at a cheaper price. Lavatory hand and face air dryers are an example of this. If all club facilities switched to this equipment, there would be no need to carry the high quality hand towel currently used. This would not only eliminate another variety of hand towels now stocked, but would also reduce plumbing and trash disposal expenses associated with it.

The use of concentrates rather than premixed products has the potential to create large savings. Some of the facilities currently use concentrate dispensers which automatically provide the proper ratios of mix. Windex, a brand name window cleaner, is available in a concentrate as well as a premixed solution. No activity is presently using the concentrate and mixing it themselves, and yet, when properly mixed, it is exactly the same as the premixed product.

#### **D. SUMMARY AND CONCLUSIONS**

This study determined the feasibility of standardizing certain non-perishable products procured with Non Appropriated Fund (NAF) resources, buying them in bulk and issuing them through a new warehouse facility.

The analysis of available data indicates that it is not economically justifiable to establish a new warehouse facility in order to make large quantity purchases with subsequent distribution to customer activities.

In view of the conclusion, this study provides several cost saving measures which, if adopted by the organization, will result in substantial savings in outlays.

Regardless of which measures are taken to reduce costs in the procurement of consumable products, if the general manager is not aware of the advantages of standardization, or concerned with seeking out cost saving measures, and is not particularly interested in either activity, it is unlikely that lower levels of management and subordinate employees will be sympathetic or co-operative.

## REFERENCES

*ARMY Regulation 215, Moral, Welfare and Recreation*, U.S. Army, 1988.

Baily, P.D., and Farmer, D.K., *Purchasing Principles and Techniques*, Pitman Publishing Ltd., 1978.

Batchelder, H.E., and others, *An Introduction to Equipment Cost Estimating*, Rand Corp., 1969.

Chorafas, D.N., *Warehousing*, American Elsevier Publishing Co., Inc., 1974.

*Defense Standardization and Specification Program (DSSP)*, Office of the Undersecretary of Defense for Research and Engineering, 1983.

*Fort Ord Regulation 10-2*, Fort Ord, 1988.

Jenkins, C.H., *Modern Warehouse Management*, McGraw Hill, 1968.

*Standardization Manual*, National Association of Purchasing Agents, 1961.

Rudke, M.B., *Manual of Cost Reduction Techniques*, McGraw Hill, 1972.

Toth, R.B., *The Economics of Standardization*, Standards Engineering Society, 1984.

**APPENDIX A  
PURCHASE TOTALS FOR FY89**

ITEM	UNIT OF ISSUE	YEARLY DEMAND	FY89 TOTAL COST	FY89 ORDERS
Bleach	gallon	3495	\$3,804.85	30
Ashtray	case	11	249.16	9
Broom, upright	case	44	1,553.13	16
Insecticide	can	288	1,857.08	9
Cap, food handler	box	81	106.02	6
Sterno	case	63	2,464.68	22
All Purpose Cleaner	gallon	1655	13,422.22	67
Sponge	each	54	39.59	7
Carpet Shampoo	gallon	288	2,254.17	20
Cleaner, glass	gallon	876	1,586.59	19
Hand Dishwashing Det.	case	34	612.25	24
60 watt light bulb	case	11	207.76	4
Doilies, small	package	7	77.56	3
Drain Opener	case	3	324.92	3
Food Tray #1000	case	8	168.25	6
Terry Bar Mop	package	30	370.75	7
Food Tray #300	case	3	56.80	3
Scouring Pad	package	69	141.59	9
Glasses, plastic 8 oz	case	8	179.15	7
Glasses, plastic 10 oz	case	24	457.00	7
Individually Wrapped Plastic Glasses	case	176	4,598.40	8
Glasses, plastic 12 oz	case	230	6,460.10	51
75 watt light bulb	package	61	236.90	4
3-way light bulb	case	5	114.00	1
Maxiclean	5 gal	57	1,179.22	11
Copy Paper 8x11	ream	270	707.54	11

ITEM	UNIT OF ISSUE	YEARLY DEMAND	FY89 TOTAL COST	FY89 ORDERS
Paper Placemat	case	66	972.02	33
Dinner Napkin	case	91	3,757.70	59
Shampoo, personal	case	23	1,130.99	5
Shaving Gel, personal	case	2	120.04	2
Solid Power	case	74	3,981.98	23
Plastic Beer Pitcher	case	26	741.00	12
Sip Stick	case	27	318.95	12
Stir Stick	case	4	58.67	3
Styrofoam Cup, 10 oz	case	17	299.50	11
Styrofoam Cup, 12 oz	case	9	187.00	9
Frill Toothpick	case	15	387.50	14
Toothpick	case	3	58.12	3
Bowl, plastic 12 oz	case	44	1,553.13	16
Cleaner, tub	quart	892	2,815.17	21
Candle, 15 hour	case	16	271.15	5
Candle, tapered	case	12	540.00	6
Carryout Container, L.	case	37	959.37	23
Carryout Container, S.	case	13	368.06	11
Oven Cleaner	case	87	1,902.88	24
Cleanser, powder	can	227	384.04	14
Descaler	gallon	137	803.55	20
Hand Cleaner Lotion	gal	28	496.86	6
Disinfectant	case	72	5,149.09	36
Doilies, large	case	16	266.91	6
Plastic Food Film	roll 12"x2000'	62	297.07	6
Plastic Food Film	roll 18"x2000'	80	1,135.73	21
Aluminum Foil	case	10	827.93	10
Food Tray #500	case	16	361.35	10

ITEM	UNIT OF ISSUE	YEARLY DEMAND	FY89 TOTAL COST	FY89 ORDERS
Glasses, plastic 5 oz	case	17	806.30	13
Styro Cup Lids 8 oz	case	9	116.15	8
Styrofoam Cup 8 oz	case	65	950.53	36
Straws	case	5	197.50	4
Toilet Paper	package	4320	6,339.15	47
Urinal Block	case	18	176.86	6
Trashbag, small	case	344	6,657.03	82
Trashbag, large	case	219	6,646.60	52
Handiwipes	case	67	1,754.47	28
Laundry Detergent	50# box	105	2,485.93	14
Grease Cutter	case	153	5,256.58	34
Conditioner, personal	case	12	721.32	3
Tooth Brush/Paste, per.	case	15	715.85	4
Furniture Polish	case	24	640.03	10
Dishwasher Rinse	5 gal	19	1,629.21	20
Glasses, plastic 9 oz	case	177	3,606.53	35
Mop, Yacht	each	181	816.11	18
Styro Cup Lids, 10 oz	case	1	12.67	1
Styro Lids, 12oz Bowl	case	1	16.50	1
Matches	case	20	389.40	15
Cocktail Napkins	case	111	1,772.64	48
Dispenser Napkins	case	18	714.30	14
Seatcover	case	4	197.57	4
Facial Tissue	case	70	1,388.68	19
Solitaire	case	28	2,237.11	25
Copy Paper 8x14	ream	50	135.50	3
<b>TOTAL FY89 ORDERS</b>				<b>1329</b>
<b>TOTAL FY89 COST</b>			<b>119,755.96</b>	

## APPENDIX B

### ECONOMIC AND QUARTERLY ORDER QUANTITY CALCULATIONS

Item:	Bleach	Unit of Issue:	Gal
Demand per year (D)		=	3495
Order or setup cost per order (Co)		=	16
Holding cost per unit per year (Ch)		=	.13
Unit cost (C)		=	.79

#### Economic Order Quantity Analysis:

EOQ	=	927.52
Order interval(yr)	=	0.26
Ordering cost	=	60.28
Holding cost	=	60.28
Subtotal of inventory cost per year	=	120.57
Material cost per year	=	2761.05
Total cost per year	=	2881.62

#### Quarterly Order Quantity Analysis:

Assigned order quantity	=	874
Order interval(yr)	=	0.25
Ordering cost	=	63.98
Holding cost	=	56.81
Subtotal of inventory cost per year	=	120.79
Material cost per year	=	2761.05
Total cost per year	=	2881.84

Diff b/t EOQ and Quarterly Qty	=	.21
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Item:	Broom, Upright	Unit of Issue:	Case
Demand per year (D)		=	2
Order or setup cost per order (Co)		=	16
Holding cost per unit per year (Ch)		=	6.65
Unit cost (C)		=	41.58

Economic Order Quantity Analysis:

EOQ	=	3.10
Order interval(yr)	=	1.55
Ordering cost	=	10.31
Holding cost	=	10.31
Subtotal of inventory cost per year	=	20.63
Material cost per year	=	83.16
Total cost per year	=	103.79

Quarterly Order Quantity Analysis:

Assigned order quantity	=	2
Order interval(yr)	=	0.25
Ordering cost	=	64.00
Holding cost	=	1.66
Subtotal of inventory cost per year	=	65.66
Material cost per year	=	148.82
Total cost per year	=	45.03
Diff b/t EOQ and Quarterly Qty	=	14.70

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Item:	Incecticide	Unit of Issue:	Cans, Aerosol
Demand per year (D)		=	288
Order or setup cost per order (Co)		=	16
Holding cost per unit per year (Ch)		=	.14
Unit cost (C)		=	.87

Economic Order Quantity Analysis:

EOQ	=	256.57
Order interval(yr)	=	0.89
Ordering cost	=	17.96
Holding cost	=	17.96
Subtotal of inventory cost per year	=	35.92
Material cost per year	=	250.56
Total cost per year	=	286.48

Quarterly Order Quantity Analysis:

Assigned order quantity	=	72
Order interval(yr)	=	0.25
Ordering cost	=	64.00
Holding cost	=	5.04
Subtotal of inventory cost per year	=	69.04
Material cost per year	=	250.56
Total cost per year	=	319.60
Diff b/t EOQ and Quarterly Qty	=	33.12

Item:	Cap, Food Handler	Unit of Issue:	Box
Demand per year (D)	=	81	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	.45	
Unit cost (C)	=	2.84	

Economic Order Quantity:

EOQ	=	75.89
Order interval(yr)	=	0.93
Ordering cost	=	17.07
Holding cost	=	17.07
Subtotal of inventory cost per year	=	34.15
Material cost per year	=	230.04
Total cost per year	=	264.19

Quarterly Order Quantity Analysis:

Assigned order quantity	=	20
Order interval(yr)	=	.24
Ordering cost	=	64.80
Holding cost	=	4.50
Subtotal of inventory cost per year	=	69.30
Material cost per year	=	230.04
Total cost per year	=	299.34
Diff b/t EOQ and Quarterly Qty	=	35.15

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Item:	Sterno	Unit of Issue:	Case
Demand per year (D)	=	63	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	5.76	
Unit cost (C)	=	36.01	

Economic Order Quantity Analysis:

EOQ	=	18.70
Order interval(yr)	=	.29
Ordering cost	=	53.88
Holding cost	=	53.88
Subtotal of inventory cost per year	=	107.76
Material cost per year	=	2269.12
Total cost per year	=	2376.88

Quarterly Order Quantity Analysis:

Assigned order quantity	=	16
Order interval(yr)	=	.25
Ordering cost	=	63.00
Holding cost	=	46.08
Subtotal of inventory cost per year	=	109.08
Material cost per year	=	2268.00
Total cost per year	=	2377.08
Diff b/t EOQ and Quarterly Qty	=	.20

Item:	All Purpose Cleaner	Unit of Issue:	Gal
Demand per year (D)	=	1655	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	.43	
Unit cost (C)	=	2.69	

Economic Order Quantity Analysis:

EOQ	=	350.94
Order interval(yr)	=	.21
Ordering cost	=	75.45
Holding cost	=	75.45
Subtotal of inventory cost per year	=	150.90
Material cost per year	=	4451.95
Total cost per year	=	4602.85

Quarterly Order Quantity Analysis:

Assigned order quantity	=	350.94
Order interval(yr)	=	.21
Ordering cost	=	75.45
Holding cost	=	75.45
Subtotal of inventory cost per year	=	150.90
Material cost per year	=	4451.95
Total cost per year	=	4602.85
Diff b/t EOQ and Quarterly Qty	=	.00

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Item:	Sponge	Unit of Issue:	Package
Demand per year (D)	=	54	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	.11	
Unit cost (C)	=	.67	

Economic Order Quantity Analysis:

EOQ	=	125.33
Order interval(yr)	=	2.32
Ordering cost	=	6.89
Holding cost	=	6.89
Subtotal of inventory cost per year	=	13.78
Material cost per year	=	36.18
Total cost per year	=	49.96

Quarterly Order Quantity Analysis:

Assigned order quantity	=	14
Order interval(yr)	=	.25
Ordering cost	=	61.71
Holding cost	=	.77
Subtotal of inventory cost per year	=	62.48
Material cost per year	=	36.18
Total cost per year	=	98.66
Diff b/t EOQ and Quarterly Qty	=	48.70

Item:	Carpet Shampoo	Unit of Issue:	Gal
Demand per year (D)	=	288	
Holding cost per unit per year	=	.94	
Order or setup cost per order (Co)	=	16	
Unit cost (C)	=	5.88	

Economic Order Quantity Analysis:

EOQ	=	98.83
Order interval(yr)	=	0.34
Ordering cost	=	46.62
Holding cost	=	46.62
Subtotal of inventory cost per year	=	93.24
Material cost per year	=	1694.01
Total cost per year	=	1787.26

Quarterly Order Quantity Analysis:

Assigned order quantity	=	72
Order interval(yr)	=	0.25
Ordering cost	=	64.00
Holding cost	=	33.84
Subtotal of inventory cost per year	=	97.84
Material cost per year	=	1692.00
Total cost per year	=	1789.84
Diff b/t EOQ and Quarterly Qty	=	2.58

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Item:	Cleaner, Glass	Unit of Issue:	Gal
Demand per year (D)	=	876	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	0.24	
Unit cost (C)	=	1.52	

Economic Order Quantity Analysis:

EOQ	=	341.76
Order interval(yr)	=	0.39
Ordering cost	=	41.01
Holding cost	=	41.01
Subtotal of inventory cost per year	=	82.02
Material cost per year	=	1331.52
Total cost per year	=	1413.54

Quarterly Order Quantity Analysis:

Assigned order quantity	=	216
Order interval(yr)	=	0.24
Ordering cost	=	64.89
Holding cost	=	25.92
Subtotal of inventory cost per year	=	90.81
Material cost per year	=	1331.52
Total cost per year	=	1422.32
Dif b/t EOQ and Quartely Qty	=	8.78

Item:	Hand Dishwashing Detergent	Unit of Issue:	Case
Demand per year (D)	=	34	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	1.96	
Unit cost (C)	=	12.22	

Economic Order Quantity Analysis:

EOQ	=	23.56
Order interval(yr)	=	.69
Ordering cost	=	23.08
Holding cost	=	23.08
Subtotal of inventory cost per year	=	46.17
Material cost per year	=	415.48
Total cost per year	=	461.65

Quarterly Order Quantity Analysis:

Assigned order quantity	=	9
Order interval	=	.26
Ordering cost	=	60.44
Holding cost	=	8.82
Subtotal of inventory cost per year	=	69.26
Material cost per year	=	415.48
Total cost per year	=	484.74
Dif b/t EOQ and Quarterly Qty	=	23.09

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Item:	60 Watt Lightbulb	Unit of Issue:	Case
Demand per year (D)	=	11	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	1.57	
Unit cost (C)	=	9.84	

Economic Order Quantity Analysis:

EOQ	=	14.97
Order interval(yr)	=	1.36
Ordering cost	=	11.75
Holding cost	=	11.75
Subtotal of inventory cost per year	=	23.50
Material cost per year	=	108.24
Total cost per year	=	131.74

Quarterly Order Quantity Analysis:

Assigned order quantity	=	2
Order interval(yr)	=	.18
Ordering cost	=	88.00
Holding cost	=	1.57
Subtotal of inventory cost per year	=	89.57
Material cost per year	=	108.24
Total cost per year	=	197.81
Diff b/t EOQ and Quarterly Qty	=	66.07

Item	:	Doilies, Small	Unit of Issue:	Package
Demand per year (D)	=		7	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		1.78	
Unit cost (C)	=		11.10	

Economic Order Quantity Analysis:

EOQ	=	11.21
Order interval(yr)	=	1.60
Ordering cost	=	9.98
Holding cost	=	9.98
Subtotal of inventory cost per year	=	19.96
Material cost per year	=	77.70
Total cost per year	=	97.66

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	.14
Ordering cost	=	112.00
Holding cost	=	.89
Subtotal of inventory cost per year	=	112.89
Material cost per year	=	77.70
Total cost per year	=	190.59
Dif b/t EOQ and Quarterly Qty	=	92.93

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Item	:	Drain Opener	Unit of Issue:	Case
Demand per year (D)	=		3	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		2.72	
Unit cost (C)	=		17.01	

Economic Order Quantity Analysis:

EOQ	=	5.94
Order interval(yr)	=	1.98
Ordering cost	=	8.08
Holding cost	=	8.08
Subtotal of inventory cost per year	=	16.15
Material cost per year	=	51.03
Total cost per year	=	67.18

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	.33
Ordering cost	=	48.00
Holding cost	=	1.36
Subtotal of inventory cost per year	=	49.36
Material cost per year	=	51.03
Total cost per year	=	100.39
Diff b/t EOQ and Quarterly Qty	=	33.21

Item	:	Food Tray 1000	Unit of Issue:	Case
Demand per year (D)	=		8	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		2.96	
Unit cost (C)	=		18.50	

Economic Order Quantity Analysis:

EOQ	=	9.30
Order interval(yr)	=	1.16
Ordering cost	=	13.76
Holding cost	=	13.76
Subtotal of inventory cost per year	=	27.52
Material cost per year	=	148.00
Total cost per year	=	175.52

Quarterly Order Quantity Analysis:

Assigned order quantity	=	2
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	2.96
Subtotal of inventory cost per year	=	66.96
Material cost per year	=	148.00
Total cost per year	=	214.96
Dif b/t EOQ and Quarterly Qty	=	39.44

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Item	:	Terry Bar Mops	Unit of Issue:	Package
Demand per year (D)	=		30	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		1.27	
Unit cost (C)	=		7.95	

Economic Order Quantity Analysis:

EOQ	=	27.49
Order interval(yr)	=	.91
Ordering cost	=	17.45
Holding cost	=	17.45
Subtotal of inventory cost per year	=	34.91
Material cost per year	=	238.50
Total cost per year	=	273.41

Quarterly Order Quantity Analysis:

Assigned order quantity	=	8
Order interval(yr)	=	.26
Ordering cost	=	60.00
Holding cost	=	5.08
Subtotal of inventory cost per year	=	65.08
Material cost per year	=	238.50
Total cost per year	=	303.58
Dif b/t EOQ and Quarterly Qty	=	30.17

Item:	Food Tray #300	Unit of Issue:	Case
Demand per year (D)	=	3	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	2.80	
Unit cost (C)	=	17.50	

Economic Order Quantity Analysis:

EOQ	=	1
Order Interval(yr)	=	.33
Ordering cost	=	48.00
Holding cost	=	1.40
Subtotal of inventory cost per year	=	49.40
Material cost per year	=	52.50
Total cost per year	=	101.90

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order Interval(yr)	=	.33
Ordering cost	=	48.00
Holding cost	=	1.40
Subtotal of inventory cost per year	=	49.40
Material cost per year	=	52.50
Total cost per year	=	101.90
Diff b/t EOQ and Quarterly Qty	=	.00

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Item:	Scouring Powder	Unit of Issue:	Case
Demand per year (D)	=	4	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	1.79	
Unit cost (C)	=	11.21	

Economic Order Quantity Analysis:

EOQ	=	8.45
Order interval(yr)	=	2.11
Ordering cost	=	7.56
Holding cost	=	7.56
Subtotal of inventory cost per year	=	15.13
Material cost per year	=	44.84
Total cost per year	=	59.97

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval	=	.25
Ordering cost	=	64.00
Holding cost	=	.89
Subtotal of inventory cost per year	=	64.89
Material cost per year	=	44.84
Total cost per year	=	109.73
Diff b/t EOQ and Quarterly Qty	=	49.76



Item:	Glass, Plastic 8 oz	Unit of Issue:	Case
Demand per year (D)	=	8	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.68	
Unit cost (C)	=	23.00	

Economic Order Quantity Analysis:

EOQ	=	8.34
Order interval(yr)	=	1.04
Ordering cost	=	15.34
Holding cost	=	15.34
Subtotal of inventory cost per year	=	30.69
Material cost per year	=	184.00
Total cost per year	=	214.69

Quarterly Order Quantity Analysis:

Assigned order quantity	=	2
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	3.68
Subtotal of inventory cost per year	=	67.68
Material cost per year	=	184.00
Total cost per year	=	251.68
Diff b/t EOQ and Quarterly Qty	=	36.99

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Item:	Glass, Plastic 10 oz	Unit of Issue:	Case
Demand per year (D)	=	24	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.03	
Unit cost (C)	=	18.95	

Economic Order QUantity Analysis:

EOQ	=	15.92
Order interval(yr)	=	.66
Ordering cost	=	24.12
Holding cost	=	24.12
Subtotal of inventory cost per year	=	48.23
Material cost per year	=	454.80
Total cost per year	=	503.03

Quarterly Order Quantity Analysis:

Assigned order quantity	=	6
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	9.09
Subtotal of inventory cost per year	=	73.09
Material cost per year	=	454.80
Total cost per year	=	527.89
Dif b/t EOQ and Quarterly Qty	=	24.86

Item:Individually Wrapped Plastic Glass	Unit of Issue:	Case
Demand per year (D)	=	176
Order or setup cost per order (Co)	=	16
Holding cost per unit per year (Ch)	=	3.62
Unit cost (C)	=	22.60
<u>Economic Order Quantity Analysis:</u>		
EOQ	=	39.44
Order interval(yr)	=	.22
Ordering cost	=	71.39
Holding cost	=	71.39
Subtotal of inventory cost per year	=	142.78
Material cost per year	=	3977.60
Total cost per year	=	4120.38
<u>Quarterly Order Quantity Analysis:</u>		
Assigned order quantity	=	39.44
Order interval(yr)	=	.22
Ordering cost	=	71.39
Holding cost	=	71.39
Subtotal of inventory cost per year	=	142.78
Material cost per year	=	3977.60
Total cost per year	=	4120.38
Diff b/t EOQ and Quarterly Qty	=	.00

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Item:	Plastic Glass, 12oz	Unit of Issue:	Case
Demand per year (D)	=	230	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	4.08	
Unit cost (C)	=	25.50	
<u>Economic Order Quantity Analysis:</u>			
EOQ	=	42.47	
Order interval(yr)	=	.18	
Ordering cost	=	86.64	
Holding cost	=	86.64	
Subtotal of inventory cost per year	=	173.28	
Material cost per year	=	5865.00	
Total cost per year	=	6038.28	
<u>Quarterly Order Quantity Analysis:</u>			
Assigned order quantity	=	42.47	
Order interval(yr)	=	.18	
Ordering cost	=	86.64	
Holding cost	=	86.64	
Subtotal of inventory cost per year	=	173.28	
Material cost per year	=	5865.00	
Total cost per year	=	6038.28	
Diff b/t EOQ and Quarterly Qty	=	.00	

Item:	75 Watt Light Bulb	Unit of Issue:	Package
Demand per year (D)	=	61	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	.28	
Unit cost (C)	=	1.75	

Economic Order Quantity Analysis:

EOQ	=	83.49
Order interval(yr)	=	1.36
Ordering cost	=	11.68
Holding cost	=	11.68
Subtotal of inventory cost per year	=	23.37
Material cost per year	=	106.75
Total cost per year	=	130.12

Quarterly Order Quantity Analysis:

Assigned order quantity	=	16
Order interval(yr)	=	.26
Ordering cost	=	61.00
Holding cost	=	2.24
Subtotal of inventory cost per year	=	63.24
Material cost per year	=	106.75
Total cost per year	=	169.99
Dif b/t EOQ and Quarterly Qty	=	39.87

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Item:	3-Way Light Bulb	Unit of Issue:	Case
Demand per year (D)	=	5	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	1.45	
Unit cost (C)	=	9.07	

Economic Order Quantity Analysis:

EOQ	=	10.50
Order interval(yr)	=	2.10
Ordering cost	=	7.61
Holding cost	=	7.61
Subtotal of inventory cost per year	=	15.23
Material cost per year	=	45.35
Total cost per year	=	60.58

Quarterly Order Quantity Analysis:

Assigned order quantity	=	2
Order interval(yr)	=	.40
Ordering cost	=	40.00
Holding cost	=	1.45
Subtotal of inventory cost per year	=	41.45
Material cost per year	=	45.35
Total cost per year	=	86.80
Dif b/t EOQ and Quarterly Qty	=	26.22

Item: MaxiClean Unit of Issue: 5 Gal Pail

Demand per year (D) = 28  
 Order or setup cost per order (Co) = 16  
 Holding cost per unit per year (Ch) = 4.97  
 Unit cost (C) = 31.06

Economic Order Quantity Analysis

EOQ = 13.42  
 Order interval(yr) = .47  
 Ordering cost = 33.37  
 Holding cost = 33.37  
 Subtotal of inventory cost per year = 66.74  
 Material cost per year = 869.89  
 Total cost per year = 936.63

Quarterly Order Quantity Analysis:

Assigned order quantity = 7  
 Order interval(yr) = .25  
 Ordering cost = 64.00  
 Holding cost = 20.47  
 Subtotal of inventory cost per year = 84.47  
 Material cost per year = 1023.40  
 Total cost per year = 1107.87  
 Dif b/t EOQ and Quarterly Qty = 171.24

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 Item: Copy Paper 8x11 Unit Of Issue: Ream

Demand per year (D) = 270  
 Order or setup cost per order (Co) = 16  
 Holding cost per unit per year (Ch) = .49  
 Unit cost (C) = 3.04

Economic Order Quantity Analysis:

EOQ = 132.78  
 Order interval(yr) = .49  
 Ordering cost = 32.53  
 Holding cost = 32.53  
 Subtotal of inventory cost per year = 65.06  
 Material cost per year = 820.80  
 Total cost per year = 885.86

Quarterly Order Quantity Analysis:

Assigned order quantity = 68  
 Order interval(yr) = .25  
 Ordering cost = 63.52  
 Holding cost = 16.66  
 Subtotal of inventory cost per year = 80.18  
 Material cost per year = 820.80  
 Total cost per year = 900.98  
 Diff b/t EOQ and Quarterly Qty = 15.12

Item:	Paper Placemat	Unit of Issue:	Case
Demand per year (D)	=	66	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	1.84	
Unit cost (C)	=	11.50	

Economic Order Quantity Analysis:

EOQ	=	33.88
Order interval(yr)	=	.51
Ordering cost	=	31.16
Holding cost	=	31.17
Subtotal of inventory cost per year	=	62.33
Material cost per year	=	759.00
Total cost per year	=	821.33

Quarterly Quantity Order Analysis:

Assigned order quantity	=	17
Order interval(yr)	=	.25
Ordering cost	=	62.11
Holding cost	=	15.64
Subtotal of inventory cost per year	=	77.75
Material cost per year	=	759.00
Total cost per year	=	836.75
Diff b/t EOQ and Quarterly Qty	=	15.42

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Item:	Dinner Napkin	Unit of Issue:	Case
Demand per year (D)	=	91	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	5.59	
Unit cost (C)	=	34.98	

Economic Order Quantity Analysis:

EOQ	=	22.80
Order interval(yr)	=	.25
Ordering cost	=	63.83
Holding cost	=	63.83
Subtotal of inventory cost per year	=	127.66
Material cost per year	=	3183.45
Total cost per year	=	3311.12

Quarterly Order Quantity Analysis:

Assigned order quantity	=	22.80
Order interval(yr)	=	.25
Ordering cost	=	63.83
Holding cost	=	63.83
Subtotal of inventory cost per year	=	127.66
Material cost per year	=	3183.45
Total cost per year	=	3311.12
Diff b/t EOQ and Quarterly Qty	=	.00

Item	:	Shampoo, Personal	Unit of Issue:	Case
Demand per year (D)	=		23	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		6.64	
Unit cost (C)	=		41.5	

Economic Order Quantity Analysis:

EOQ	=	10.52
Order interval(yr)	=	.45
Ordering cost	=	34.95
Holding cost	=	34.95
Subtotal of inventory cost per year	=	69.90
Material cost per year	=	954.50
Total cost per year	=	1024.40

Quarterly Order Quantity Analysis:

Assigned order quantity	=	6
Order interval(yr)	=	.26
Ordering cost	=	61.33
Holding cost	=	19.92
Subtotal of inventory cost per year	=	81.25
Material cost per year	=	954.50
Total cost per year	=	1035.75
Dif b/t EOQ and Quarterly Qty	=	11.35

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Item	:	Shaving Gel, Personal	Unit of Issue:	Case
Demand per year (D)	=		2	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		7.99	
Unit cost (C)	=		49.95	

Economic Order Quantity Analysis:

EOQ	=	1
Order interval(yr)	=	.50
Ordering cost	=	32.00
Holding cost	=	3.99
Subtotal of inventory cost per year	=	35.99
Material cost per year	=	99.90
Total cost per year	=	135.89

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	.50
Ordering cost	=	32.00
Holding cost	=	3.99
Subtotal of inventory cost per year	=	35.99
Material cost per year	=	99.90
Total cost per year	=	135.89
Dif b/t EOQ and Quarterly Qty	=	.00

Item:	Solid Power	Unit of Issue:	Case
Demand per year (D)	=	74	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	8.56	
Unit cost (C)	=	53.51	

Economic Order Quantity Analysis:

EOQ	=	16.63
Order interval(yr)	=	.22
Ordering cost	=	71.18
Holding cost	=	71.18
Subtotal of inventory cost per year	=	142.37
Material cost per year	=	3959.74
Total cost per year	=	4102.11

Quarterly Order Quantity Analysis:

Assigned Order Quantity	=	16.63
Order interval(yr)	=	.22
Ordering cost	=	71.18
Holding cost	=	71.18
Subtotal of inventory cost per year	=	142.37
Material cost per year	=	3959.74
Total cost per year	=	4102.11
Diff b/t EOQ and Quarterly Qty	=	.00

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Item:	Plastic Beer Pitcher	Unit of Issue:	Case
Demand per year (D)	=	26	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	.97	
Unit cost (C)	=	6.04	

Economic Order Quantity Analysis:

EOQ	=	13.50
Order interval(yr)	=	.52
Ordering cost	=	30.79
Holding cost	=	30.79
Subtotal of inventory cost per year	=	61.59
Material cost per year	=	741.00
Total cost per year	=	802.59

Quarterly Order Quantity Analysis:

Assigned order quantity	=	6
Order interval(yr)	=	.23
Ordering cost	=	69.33
Holding cost	=	13.68
Subtotal of inventory cost per year	=	83.01
Material cost per year	=	741.00
Total cost per year	=	824.01
Diff b/t EOQ and Quarterly Qty	=	17.41

Item:	Sip Stick	Unit of Issue:	Case
Demand per year (D)	=	27	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	1.91	
Unit cost (C)	=	11.95	

Economic Order Quantity Analysis:

EOQ	=	21.26
Order interval(yr)	=	.78
Ordering cost	=	20.31
Holding cost	=	20.31
Subtotal of inventory cost per year	=	40.62
Material cost per year	=	322.65
Total cost per year	=	363.27

Quarterly Order Quantity Analysis:

Assigned order quantity	=	7
Order interval(yr)	=	.25
Ordering cost	=	61.71
Holding cost	=	6.68
Subtotal of inventory cost per year	=	68.39
Material cost per year	=	322.65
Total cost per year	=	391.04
Diff b/t EOQ and Quarterly Qty	=	27.77

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Item:	Stir Stick	Unit of Issue:	Case
Demand per year (D)	=	4	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	2.78	
Unit cost (C)	=	17.35	

Economic Order Quantity Analysis:

EOQ	=	6.78
Order interval(yr)	=	1.69
Ordering cost	=	9.43
Holding cost	=	9.43
Subtotal of inventory cost per year	=	18.86
Material cost per year	=	69.40
Total cost per year	=	88.26

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	1.39
Subtotal of inventory cost per year	=	65.39
Material cost per year	=	69.40
Total cost per year	=	134.79
Diff b/t EOQ and Quarterly Qty	=	46.53



Item:	Styrofoam Cup, 10oz	Unit of Issue:	Case
Demand per year (D)	=	17	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	2.21	
Unit cost (C)	=	13.83	

Economic Order Quantity Analysis:

EOQ	=	15.68
Order interval(yr)	=	.92
Ordering cost	=	17.33
Holding cost	=	17.33
Subtotal of inventory cost per year	=	34.67
Material cost per year	=	235.11
Total cost per year	=	269.78

Quarterly Order Quantity Analysis:

Assigned order quantity	=	4
Order interval(yr)	=	.23
Ordering cost	=	68.00
Holding cost	=	4.42
Subtotal of inventory cost per year	=	72.42
Material cost per year	=	235.11
Total cost per year	=	307.53
Diff b/t EOQ and Quarterly Qty	=	37.75

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Item:	Styrofoam Cup, 12oz	Unit of Issue:	Case
Demand per year (D)	=	9	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.27	
Unit cost (C)	=	20.45	

Economic Order Quantity Analysis:

EOQ	=	9.38
Order interval(yr)	=	1.04
Ordering cost	=	15.34
Holding cost	=	15.34
Subtotal of inventory cost per year	=	30.68
Material cost per year	=	184.05
Total cost per year	=	214.73

Quarterly Order Quantity Analysis:

Assigned order quantity	=	2
Order interval(yr)	=	.22
Ordering cost	=	72.00
Holding cost	=	3.27
Subtotal of inventory cost per year	=	75.27
Material cost per year	=	184.05
Total cost per year	=	259.32
Diff b/t EOQ and Quarterly Qty	=	44.59

Item:	Frill Toothpicks	Unit of Issue:	Case
Demand per year (D)	=	15	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.83	
Unit cost (C)	=	23.95	

Economic Order Quantity Analysis:

EOQ	=	11.19
Order interval(yr)	=	.74
Ordering cost	=	21.43
Holding cost	=	21.43
Subtotal of inventory cost per year	=	42.87
Material cost per year	=	359.25
Total cost per year	=	402.12

Quarterly Order Quantity Analysis:

Assigned order quantity	=	4
Order interval(yr)	=	.26
Ordering cost	=	60.00
Holding cost	=	7.66
Subtotal of inventory cost per year	=	67.66
Material cost per year	=	359.25
Total cost per year	=	426.91
Diff b/t EOQ and Quarterly Qty	=	24.79

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Item:	Toothpick	Unit of Issue:	Case
Demand per year (D)	=	3	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	2.87	
Unit cost (C)	=	17.95	

Economic Order Quantity Analysis:

EOQ	=	5.78
Order interval(yr)	=	1.92
Ordering cost	=	8.29
Holding cost	=	8.29
Subtotal of inventory cost per year	=	16.59
Material cost per year	=	53.85
Total cost per year	=	70.44

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	.33
Ordering cost	=	48.00
Holding cost	=	1.43
Subtotal of inventory cost per year	=	49.43
Material cost per year	=	53.85
Total cost per year	=	103.28
Diff b/t EOQ and Quarterly Qty	=	32.84

Item:	Bowl, Plastic 12oz	Unit of Issue:	Case
Demand per year (D)	=	44	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	4.42	
Unit cost (C)	=	27.62	

Economic Order Quantity Analysis:

EOQ	=	17.0
Order interval(yr)	=	
Ordering cost	=	30
Holding cost	=	39.44
Subtotal of inventory cost per year	=	78.88
Material cost per year	=	1215.50
Total cost per year	=	1294.38

Quarterly Order Quantity Analysis:

Assigned order quantity	=	11
Order interval	=	0.25
Ordering cost	=	64.00
Holding cost	=	24.31
Subtotal of inventory cost per year	=	88.31
Material cost per year	=	1214.40
Total cost per year	=	1302.71
Diff b/t EOQ and Quarterly Qty	=	8.33

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Item:	Cleaner, Tub	Unit of Issue:	Qt
Demand per year (D)	=	892	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	.17	
Unit cost (C)	=	1.08	

Economic Order Quantity Analysis:

EOQ	=	409.76
Order interval(yr)	=	0.46
Ordering cost	=	34.83
Holding cost	=	34.83
Subtotal of inventory cost per year	=	69.66
Material cost per year	=	963.36
Total cost per year	=	1033.02

Quarterly Order Quantity Analysis:

Assigned order quantity	=	224
Order interval(yr)	=	0.25
Ordering cost	=	63.71
Holding cost	=	19.64
Subtotal of inventory cost per year	=	82.75
Material cost per year	=	963.36
Total cost per year	=	1046.11
Diff b/t EOQ and Quarterly Qty	=	13.09

Item:	Candle, 15 Hour	Unit of Issue:	Case
Demand per year (D)	=	16	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	2.59	
Unit cost (C)	=	16.20	

Economic Order Quantity Analysis:

EOQ	=	14.05
Order interval(yr)	=	.87
Ordering cost	=	18.21
Holding cost	=	18.21
Subtotal of inventory cost per year	=	36.42
Material cost per year	=	259.20
Total cost per year	=	295.62

Quarterly Order QUantity Analysis:

Assigned order quantity	=	4
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	5.32
Subtotal of inventory cost per year	=	69.32
Material cost per year	=	265.60
Total cost per year	=	334.92
Dif b/t EOQ and Quarterly Qty	=	39.30

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Item:	Candle, Tapered	Unit of Issue:	Case
Demand per year (D)	=	12	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	7.20	
Unit cost (C)	=	45	

Economic Order Quantity Analysis:

EOQ	=	7.30
Order interval(yr)	=	.60
Ordering cost	=	26.29
Holding cost	=	26.29
Subtotal of inventory cost per year	=	52.58
Material cost per year	=	540.00
Total cost per year	=	592.58

Quarterly Order Quantity Analysis:

Assigned order quantity	=	3
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	10.80
Subtotal of inventory cost per year	=	74.80
Material cost per year	=	540.00
Total cost per year	=	614.80
Dif b/t EOQ and Quarterly Qty	=	22.22

Item:	Carryout Container, Large	Unit of Issue:	Case
Demand per year (D)	=	19	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.60	
Unit cost (C)	=	22.50	

Economic Order Quantity Analysis:

EOQ	=	12.99
Order interval(yr)	=	0.68
Ordering cost	=	23.39
Holding cost	=	23.39
Subtotal of inventory cost per year	=	46.78
Material cost per year	=	427.50
Total cost per year	=	474.28

Quarterly Order Quantity Analysis:

Assigned order quantity	=	5
Order interval(yr)	=	0.26
Ordering cost	=	60.80
Holding cost	=	9.00
Subtotal of inventory cost per year	=	69.80
Material cost per year	=	427.50
Total cost per year	=	497.30
Diff b/t EOQ and Quarterly Qty	=	23.02

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Item:	Carryout Container, Small	Unit of Issue:	Case
Demand per year (D)	=	13	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.70	
Unit cost (C)	=	23.15	

Economic Order Quantity Analysis:

EOQ	=	10.60
Order interval(yr)	=	0.81
Ordering cost	=	19.61
Holding cost	=	19.61
Subtotal of inventory cost per year	=	39.23
Material cost per year	=	300.95
Total cost per year	=	340.18

Quarterly Order Quantity Analysis:

Assigned order quantity	=	3
Order interval(yr)	=	0.23
Ordering cost	=	69.33
Holding cost	=	5.55
Subtotal of inventory cost per year	=	74.88
Material cost per year	=	300.95
Total cost per year	=	375.83
Diff b/t EOQ and Quarterly Qty	=	35.65

Item:	Oven Cleaner	Unit of Issue:	Case
Demand per year (D)	=	87	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	2.02	
Unit cost (C)	=	12.60	

Economic Order Quantity:

EOQ	=	37.12
Order interval(yr)	=	.42
Ordering cost	=	37.49
Holding cost	=	37.49
Subtotal of inventory cost per year	=	74.99
Material cost per year	=	1096.20
Total cost per year	=	1171.19

Quarterly Order Quantity Analysis:

Assigned order quantity	=	22
Order interval(yr)	=	.25
Ordering cost	=	63.27
Holding cost	=	22.22
Subtotal of inventory cost per year	=	85.49
Material cost per year	=	1096.20
Total cost per year	=	1181.69
Diff b/t EOQ and Quarterly Qty	=	10.50

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Item:	Cleanser, Powder	Unit of Issue:	21oz Can
Demand per year (D)	=	227	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	.08	
Unit cost (C)	=	.47	

Economic Order Quantity Analysis:

EOQ	=	301.33
Order interval(yr)	=	1.32
Ordering cost	=	12.05
Holding cost	=	12.05
Subtotal of inventory cost per year	=	24.10
Material cost per year	=	106.69
Total cost per year	=	130.79

Quarterly Order Quantity Analysis:

Assigned order quantity	=	57
Order interval(yr)	=	.25
Ordering cost	=	63.71
Holding cost	=	2.28
Subtotal of inventory cost per year	=	65.99
Material cost per year	=	106.69
Total cost per year	=	172.68
Diff b/t EOQ and Quarterly Qty	=	41.89

Item	: Descaler	Unit of Issue:	Gal
Demand per year (D)		=	137
Order or setup cost per order (Co)		=	16
Holding cost per unit per year (Ch)		=	.85
Unit cost (C)		=	5.30

Economic Order Quantity:

EOQ	=	71.81
Order interval(yr)	=	.52
Ordering cost	=	30.52
Holding cost	=	30.52
Subtotal of inventory cost per year	=	61.04
Material cost per year	=	726.10
Total cost per year	=	787.14

Quarterly Order Quantity Analysis:

Assigned order quantity	=	34
Order interval(yr)	=	.24
Ordering cost	=	64.47
Holding cost	=	14.45
Subtotal of inventory cost per year	=	78.92
Material cost per year	=	726.10
Total cost per year	=	805.02
Diff b/t EOQ and Quarterly Qty	=	17.88

Item	: Hand Cleaner Lotion	Unit of Issue:	Gal
Demand per year (D)		=	28
Order or setup cost per order (Co)		=	16
Holding cost per unit per year (Ch)		=	.68
Unit cost (C)		=	4.26

Economic Order Quantity Analysis:

EOQ	=	36.29
Order interval(yr)	=	1.29
Ordering cost	=	12.34
Holding cost	=	12.34
Subtotal of inventory cost per year	=	24.68
Material cost per year	=	119.28
Total cost per year	=	143.96

Quarterly Order Quantity Analysis:

Assigned order quantity	=	7
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	2.38
Subtotal of inventory cost per year	=	66.38
Material cost per year	=	119.28
Total cost per year	=	185.66
Dif b/t EOQ and Quarterly Qty	=	41.70

Item:	Disinfectant	Unit of Issue:	Case
Demand per year (D)	=	72	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	4.74	
Unit cost (C)	=	29.60	

Economic Order Quantity Analysis:

EOQ	=	22.04
Order interval(yr)	=	.30
Ordering cost	=	52.25
Holding cost	=	52.25
Subtotal of inventory cost per year	=	104.50
Material cost per year	=	2131.20
Total cost per year	=	2235.70

Quarterly Order Quantity Analysis:

Assigned order quantity	=	18
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	42.66
Subtotal of inventory cost per year	=	106.66
Material cost per year	=	2131.20
Total cost per year	=	2237.86
Dif b/t EOQ and Quarterly Qty	=	2.16

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Item:	Doilies, Large	Unit of Issue:	Package
Demand per year (D)	=	16	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	2.96	
Unit cost (C)	=	18.50	

Economic Order Quantity Analysis:

EOQ	=	13.15
Order interval(yr)	=	.82
Ordering cost	=	19.46
Holding cost	=	19.46
Subtotal of inventory cost per year	=	38.93
Material cost per year	=	296.00
Total cost per year	=	334.93

Quarterly Order Quantity Analysis:

Assigned order quantity	=	4
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	5.92
Subtotal of inventory cost per year	=	69.92
Material cost per year	=	296.00
Total cost per year	=	365.92
Dif b/t EOQ and Quarterly Qty	=	30.99



Item: Plastic Food Film      Unit of Issue: Roll (12"x2000')

Demand per year (D)	=	62
Order or setup cost per order (Co)	=	16
Holding cost per unit per year (Ch)	=	.73
Unit cost (C)	=	4.58

Economic Order Quantity Analysis:

EOQ	=	52.13
Order interval(yr)	=	.84
Ordering cost	=	19.02
Holding cost	=	19.02
Subtotal of inventory cost per year	=	38.05
Material cost per year	=	283.96
Total cost per year	=	322.01

Quarterly Order Quantity Analysis:

Assigned order quantity	=	16
Order interval(yr)	=	.25
Ordering cost	=	62.00
Holding cost	=	5.84
Subtotal of inventory cost per year	=	67.84
Material cost per year	=	283.96
Total cost per year	=	351.80
Dif b/t EOQ and Quarterly Qty	=	29.79

-----  
Item: Plastic Food Film      Unit of Issue: Roll (18"x2000')

Demand per year (D)	=	80
Order or setup cost per order (Co)	=	16
Holding cost per unit per year (Ch)	=	2.35
Unit cost (C)	=	14.70

Economic Order Quantity Analysis:

EOQ	=	33.00
Order interval(yr)	=	.41
Ordering cost	=	38.78
Holding cost	=	38.78
Subtotal of inventory cost per year	=	77.56
Material cost per year	=	1176.00
Total cost per year	=	1253.56

Quarterly Order QUantity Analysis:

Assigned order quantity	=	20
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	23.50
Subtotal of inventory cost per year	=	87.50
Material cost per year	=	1176.00
Total cost per year	=	1263.50
Dif b/t EOQ and Quarterly Qty	=	9.94

Item: Aluminum Foil Unit of Issue: Case, 24 Rolls (18"x75')

Demand per year (D)	=	10
Order or setup cost per order (Co)	=	16
Holding cost per unit per year (Ch)	=	7.10
Unit cost (C)	=	44.35

Economic Order Quantity Analysis:

EOQ	=	6.71
Order interval(yr)	=	.67
Ordering cost	=	23.83
Holding cost	=	23.83
Subtotal of inventory cost per year	=	47.66
Material cost per year	=	443.50
Total cost per year	=	491.16

Quarterly Order Quantity Analysis:

Assigned order quantity	=	3
Order interval(yr)	=	.30
Ordering cost	=	53.33
Holding cost	=	10.65
Subtotal of inventory cost per year	=	63.98
Material cost per year	=	443.50
Total cost per year	=	507.48
Dif b/t EOQ and Quarterly Qty	=	16.32

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Item: Food Tray 500 Unit of Issue: Case

Demand per year (D)	=	16
Order or setup cost per order (Co)	=	16
Holding cost per unit per year (Ch)	=	3.51
Unit cost (C)	=	21.95

Economic Order Quantity Analysis:

Assigned order quantity	=	12.07
Order interval(yr)	=	.75
Ordering cost	=	21.20
Holding cost	=	21.20
Subtotal of inventory cost per year	=	42.40
Material cost per year	=	351.29
Total cost per year	=	393.69

Quarterly Order Quantity Analysis:

Assigned order quantity	=	4
Order interval	=	.25
Ordering cost	=	64.00
Holding cost	=	7.52
Subtotal of inventory cost per year	=	71.52
Material cost per year	=	376.00
Total cost per year	=	447.52
Dif b/t EOQ and Quarterly Qty	=	53.83

Item	:	Glass, Plastic 5 oz	Unit of Issue:	Case
Demand per year (D)	=		5	
Order or setup cost per order (Co)	=	16.00		
Holding cost per unit per year (Ch)	=	12.00		
Unit cost (C)	=	75.00		

Economic Order Quantity Analysis:

EOQ	=	3.65
Order interval(yr)	=	.73
Ordering cost	=	21.90
Holding cost	=	21.90
Subtotal of inventory cost per year	=	43.81
Material cost per year	=	375.00
Total cost per year	=	418.81

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	.20
Ordering cost	=	80.00
Holding cost	=	6.00
Subtotal of inventory cost per year	=	86.00
Material cost per year	=	375.00
Total cost per year	=	461.00
Diff b/t EOQ and Quarterly Qty	=	42.19

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Item	:	Styrofoam Cup Lid 8 Oz	Unit of Issue:	Case
Demand per year (D)	=	5		
Order or setup cost per order (Co)	=	16		
Holding cost per unit per year (Ch)	=	1.75		
Unit cost (C)	=	10.99		

Economic Order Quantity Analysis:

Assigned order quantity	=	10
Order interval(yr)	=	2.00
Ordering cost	=	8.00
Holding cost	=	8.77
Subtotal of inventory cost per year	=	16.77
Material cost per year	=	54.97
Total cost per year	=	71.75

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	.20
Ordering cost	=	80.00
Holding cost	=	.97
Subtotal of inventory cost per year	=	80.97
Material cost per year	=	60.75
Total cost per year	=	141.72
Diff b/t EOQ and Quarterly Qty	=	69.97

Item:	Plastic Glass, 9oz	Unit of Issue:	Case
Demand per year (D)	=	177	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.03	
Unit cost (C)	=	18.95	

Economic Order Quantity Analysis:

EOQ	=	43.23
Order interval(yr)	=	.24
Ordering cost	=	65.50
Holding cost	=	65.50
Subtotal of inventory cost per year	=	131.00
Material cost per year	=	3354.15
Total cost per year	=	3485.15

Quarterly Order Quantity Analysis:

Assigned order quantity	=	43.23
Order interval(yr)	=	.24
Ordering cost	=	65.50
Holding cost	=	65.50
Subtotal of inventory cost per year	=	131.00
Material cost per year	=	3354.15
Total cost per year	=	3485.15
Diff b/t EOQ and Quarterly Qty	=	.00

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Item:	Large Trashbag	Unit of Issue:	Case
Demand per year (D)	=	219	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	4.81	
Unit cost (C)	=	30.05	

Economic Order Quantity Analysis:

EOQ	=	38.16
Order interval(yr)	=	.17
Ordering cost	=	91.80
Holding cost	=	91.80
Subtotal of inventory cost per year	=	183.61
Material cost per year	=	6582.26
Total cost per year	=	6765.82

Quarterly Order Quantity Analysis:

Assigned order quantity	=	38.16
Order interval(yr)	=	.17
Ordering cost	=	91.80
Holding cost	=	91.80
Subtotal of inventory cost per year	=	183.61
Material cost per year	=	6582.26
Total cost per year	=	6765.82
Diff b/t EOQ and Quarterly Qty	=	.00

Item:	Greasecutter	Unit of Issue:	Case
Demand per year (D)	=	153	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	4.22	
Unit cost (C)	=	26.40	

Economic Order Quantity Analysis:

EOQ	=	34.06
Order interval(yr)	=	.22
Ordering cost	=	71.87
Holding cost	=	71.87
Subtotal of inventory cost per year	=	143.74
Material cost per year	=	4039.20
Total cost per year	=	4182.94

Quarterly Order Quantity Analysis:

Assigned order quantity	=	34.06
Order interval(yr)	=	.22
Ordering cost	=	71.87
Holding cost	=	71.87
Subtotal of inventory cost per year	=	143.74
Material cost per year	=	4039.20
Total cost per year	=	4182.94
Diff b/t EOQ and Quarterly Qty	=	.00

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Item:	Foodtray #200	Unit of Issue:	Case
Demand per year (D)	=	2	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.46	
Unit cost (C)	=	21.6	

Economic Order Quantity Analysis:

EOQ	=	1
Order interval(yr)	=	.50
Ordering cost	=	32.00
Holding cost	=	1.73
Subtotal of inventory cost per year	=	33.73
Material cost per year	=	43.20
Total cost per year	=	76.93

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	.50
Ordering cost	=	32.00
Holding cost	=	1.73
Subtotal of inventory cost per year	=	33.73
Material cost per year	=	43.20
Total cost per year	=	76.93
Diff b/t EOQ and Quarterly Qty	=	.00

Item	:	Styrofoam Cup Lids 10 oz	Unit of Issue:	Case
Demand per year (D)	=		1	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		2.03	
Unit cost (C)	=		12.67	

Economic Order Quantity Analysis:

EOQ	=	3.97
Order interval(yr)	=	3.97
Ordering cost	=	4.03
Holding cost	=	4.03
Subtotal of inventory cost per year	=	8.06
Material cost per year	=	12.67
Total cost per year	=	20.73

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	1.00
Ordering cost	=	16.00
Holding cost	=	1.01
Subtotal of inventory cost per year	=	17.01
Material cost per year	=	12.67
Total cost per year	=	29.68
Dif b/t EOQ and Quarterly Qty	=	8.95

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Item	:	Book Matches	Unit of Issue:	Case
Demand per year (D)	=		20	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		3.19	
Unit cost (C)	=		19.95	

Economic Order Quantity Analysis:

EOQ	=	14.16
Order interval(yr)	=	.70
Ordering cost	=	22.59
Holding cost	=	22.59
Subtotal of inventory cost per year	=	45.18
Material cost per year	=	399.00
Total cost per year	=	444.18

Quarterly Order Quantity Analysis:

Assigned order quantity	=	5
Order interval	=	.25
Ordering cost	=	64.00
Holding cost	=	7.97
Subtotal of inventory cost per year	=	71.97
Material cost per year	=	399.00
Total cost per year	=	470.97
Dif b/t EOQ and Quarterly Quantity	=	26.79

Item:	Mop, Yacht	Unit of Issue:	Each
Demand per year (D)	=	181	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	.47	
Unit cost (C)	=	2.95	

Economic Order Quantity Analysis:

EOQ	=	111.01
Order interval(yr)	=	.61
Ordering cost	=	26.08
Holding cost	=	26.08
Subtotal of inventory cost per year	=	52.17
Material cost per year	=	533.95
Total cost per year	=	586.12

Quarterly Order Quantity Analysis:

Assigned order quantity	=	45
Order interval(yr)	=	.24
Ordering cost	=	64.35
Holding cost	=	10.57
Subtotal of inventory cost per year	=	74.93
Material cost per year	=	533.95
Total cost per year	=	608.88
Diff b/t EOQ and Quarterly Qty	=	22.76

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Item:	Cocktail Napkin	Unit of Issue:	Case
Demand per year (D)	=	111	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	2.16	
Unit cost (C)	=	13.50	

Economic Order Quantity Analysis:

EOQ	=	40.55
Order interval(yr)	=	.36
Ordering cost	=	43.79
Holding cost	=	43.79
Subtotal of inventory cost per year	=	87.59
Material cost per year	=	1498.50
Total cost per year	=	1586.09

Quarterly Order Quantity Analysis:

Assigned order quantity	=	28
Order interval(yr)	=	.25
Ordering cost	=	63.42
Holding cost	=	30.24
Subtotal of inventory cost per year	=	93.66
Material cost per year	=	1498.50
Total cost per year	=	1592.16
Diff b/t EOQ and Quarterly Qty	=	6.07

Item:	Copy Paper 8x14	Unit of Issue:	Ream
Demand per year (D)	=	50	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	.56	
Unit cost (C)	=	3.50	

Economic Order Quantity Analysis:

EOQ	=	53.45
Order interval(yr)	=	1.06
Ordering cost	=	14.96
Holding cost	=	14.96
Subtotal of inventory cost per year	=	29.93
Material cost per year	=	175.00
Total cost per year	=	204.93

Quarterly Order Quantity Analysis:

Assigned order quantity	=	13
Order interval(yr)	=	.26
Ordering cost	=	61.53
Holding cost	=	3.64
Subtotal of inventory cost per year	=	65.17
Material cost per year	=	175.00
Total cost per year	=	240.17
Diff b/t EOQ and Quarterly Qty	=	35.24

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Item:	Comode Seat Cover Half Fold	Unit of Issue:	Case
Demand per year (D)	=	4	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	5.92	
Unit cost (C)	=	37.00	

Economic Order Quantity Analysis:

EOQ	=	4.65
Order interval(yr)	=	1.16
Ordering cost	=	13.76
Holding cost	=	13.76
Subtotal of inventory cost per year	=	27.52
Material cost per year	=	148.00
Total cost per year	=	175.52

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	2.96
Subtotal of inventory cost per year	=	66.96
Material cost per year	=	148.00
Total cost per year	=	214.96
Diff b/t EOQ and Quarterly Qty	=	39.44



Item	:	Furniture Polish	Unit of Issue:	Case
Demand per year (D)	=		4	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		2.4	
Unit cost (C)	=		15	

Economic Order Quantity Analysis:

EOQ	=	17.88
Order interval(yr)	=	.74
Ordering cost	=	21.46
Holding cost	=	21.46
Subtotal of inventory cost per year	=	42.93
Material cost per year	=	360.00
Total cost per year	=	402.93

Quarterly Order Quantity Analysis:

Assigned order quantity	=	6
Order interval	=	.25
Ordering cost	=	64.00
Holding cost	=	7.20
Subtotal of inventory cost per year	=	71.20
Material cost per year	=	360.00
Total cost per year	=	431.20
Dif b/t EOQ and Quarterly Qty	=	28.27

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Item	:	Hair Conditioner, Personal	Unit Of Issue:	Case
Demand per year (D)	=		12	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		6.64	
Unit cost (C)	=		41.50	

Economic Order Quantity Analysis:

EOQ	=	7.60
Order interval(yr)	=	.63
Ordering cost	=	25.24
Holding cost	=	25.24
Subtotal of inventory cost per year	=	50.49
Material cost per year	=	498.00
Total cost per year	=	548.49

Quarterly Order Quantity Analysis:

Assigned order quantity	=	3
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	9.96
Subtotal of inventory cost per year	=	73.96
Material cost per year	=	498.00
Total cost per year	=	571.96
Dif b/t EOQ and Quarterly Qty	=	23.47

Item	:	Toothpaste, Personal	Unit of Issue:	Case
Demand per year (D)	=		15	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		10.4	
Unit cost (C)	=		65.00	

Economic Order Quantity Analysis:

EOQ	=	6.79
Order interval(yr)	=	.45
Ordering cost	=	35.32
Holding cost	=	35.32
Subtotal of inventory cost per year	=	70.65
Material cost per year	=	975.00
Total cost per year	=	1045.65

Quarterly Order Quantity Analysis:

Assigned order quantity	=	4
Order interval(yr)	=	.26
Ordering cost	=	60.00
Holding cost	=	20.80
Subtotal of inventory cost per year	=	80.80
Material cost per year	=	975.00
Total cost per year	=	1055.80
Dif b/t EOQ and Quarterly Qty	=	10.15

Item	:	Dishwasher Rinse	Unit of Issue:	5 Gal Pail
Demand per year (D)	=		19	
Order or setup cost per order (Co)	=		16	
Holding cost per unit per year (Ch)	=		4.91	
Unit cost (C)	=		30.71	

Economic Order Quantity Analysis:

Assigned order quantity	=	11.12
Order interval(yr)	=	.58
Ordering cost	=	27.32
Holding cost	=	27.32
Subtotal of inventory cost per year	=	54.65
Material cost per year	=	583.50
Total cost per year	=	638.15

Quarterly Order Quantity Analysis:

Assigned order quantity	=	5
Order interval(yr)	=	.26
Ordering cost	=	60.80
Holding cost	=	14.45
Subtotal of inventory cost per year	=	75.25
Material cost per year	=	686.47
Total cost per year	=	761.72
Dif b/t EOQ and Quarterly Qty	=	123.57

Item:	Solitaire	Unit of Issue:	Case
Demand per year (D)	=	16	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	12.64	
Unit cost (C)	=	79.00	

Economic Order Quantity Analysis:

EOQ	=	6.36
Order interval(yr)	=	.39
Ordering cost	=	40.22
Holding cost	=	40.22
Subtotal of inventory cost per year	=	80.44
Material cost per year	=	1264.00
Total cost per year	=	1344.44

Quarterly Order Quantity Analysis:

Assigned order quantity	=	4
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	25.28
Subtotal of inventory cost per year	=	89.28
Material cost per year	=	1264.00
Total cost per year	=	1353.28
Diff b/t EOQ and Quarterly Qty	=	8.84

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Item:	Facial Tissue	Unit of Issue:	Case
Demand per year (D)	=	70	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	2.71	
Unit cost (C)	=	16.95	

Economic Order Quantity Analysis:

EOQ	=	28.75
Order interval	=	.41
Ordering cost	=	38.95
Holding cost	=	38.95
Subtotal of inventory cost per year	=	77.91
Material cost per year	=	1186.50
Total cost per year	=	1264.41

Quarterly Order Quantity Analysis:

Assigned order quantity	=	18
Order interval(yr)	=	.25
Ordering cost	=	62.22
Holding cost	=	24.39
Subtotal of inventory cost per year	=	86.61
Material cost per year	=	1186.50
Total cost per year	=	1273.11
Diff b/t EOQ and Quarterly Qty	=	8.70

Item:	Straws, Long	Unit of Issue:	Case
Demand per year (D)	=	4	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	5.76	
Unit cost (C)	=	36.00	

Economic Order Quantity Analysis:

EOQ	=	4.71
Order interval(yr)	=	1.17
Ordering cost	=	13.57
Holding cost	=	13.57
Subtotal of inventory cost per year	=	27.15
Material cost per year	=	144.00
Total cost per year	=	171.15

Quarterly Order Quantity Analysis:

Assigned order quantity	=	1
Order interval(yr)	=	.25
Ordering cost	=	64.00
Holding cost	=	2.88
Subtotal of inventory cost per year	=	66.88
Material cost per year	=	144.00
Total cost per year	=	210.88
Diff b/t EOQ and Quarterly Qty	=	39.73

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Item:	Styrofoam Cup 8oz	Unit of Issue:	Case
Demand per year (D)	=	65	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	1.75	
Unit cost (C)	=	10.95	

Economic Order Quantity Analysis:

EOQ	=	34.47
Order interval(yr)	=	.53
Ordering cost	=	30.16
Holding cost	=	30.16
Subtotal of inventory cost per year	=	60.33
Material cost per year	=	711.75
Total cost per year	=	772.08

Quarterly Order Quantity Analysis:

Assigned order quantity	=	16
Order interval(yr)	=	.24
Ordering cost	=	65.00
Holding cost	=	14.00
Subtotal of inventory cost per year	=	79.00
Material cost per year	=	711.75
Total cost per year	=	790.75
Diff b/t EOQ and Quarterly Qty	=	18.67

Item:	Small Trashbag	Unit of Issue:	Case
Demand per year (D)	=	344	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.12	
Unit cost (C)	=	19.50	
<u>Economic Order Quantity Analysis:</u>			
EOQ	=	59.39	
Order interval(yr)	=	.17	
Ordering cost	=	92.66	
Holding cost	=	92.66	
Subtotal of inventory cost per year	=	185.32	
Material cost per year	=	6708.00	
Total cost per year	=	6893.32	
<u>Quarterly Order Quantity Analysis:</u>			
Assigned order quantity	=	59.39	
Order interval(yr)	=	.17	
Ordering cost	=	92.66	
Holding cost	=	92.66	
Subtotal of inventory cost per year	=	185.32	
Material cost per year	=	6708.00	
Total cost per year	=	6893.32	
Diff b/ EOQ and Quarterly Qty	=	.00	

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Item:	Wipes	Unit of Issue:	Case
Demand per year (D)	=	67	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.39	
Unit cost (C)	=	21.21	
<u>Economic Order Quantity Analysis:</u>			
EOQ	=	17	
Order interval(yr)	=	.25	
Ordering cost	=	63.05	
Holding cost	=	28.81	
Subtotal of inventory cost per year	=	91.87	
Material cost per year	=	1421.07	
Total cost per year	=	1512.94	
<u>Quarterly Order Quantity Analysis:</u>			
Assigned order quantity	=	17	
Order interval(yr)	=	.25	
Ordering cost	=	63.05	
Holding cost	=	28.81	
Subtotal of inventory cost per year	=	91.87	
Material cost per year	=	1421.07	
Total cost per year	=	1512.94	
Diff b/t EOQ and Quarterly Qty	=	.00	

Item:	Laundry Detergent	Unit of Issue:	50# Box
Demand per year (D)	=	67	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.39	
Unit cost (C)	=	21.21	

Economic Order Quantity Analysis:

EOQ	=	29.73
Order interval(yr)	=	.28
Ordering cost	=	56.49
Holding cost	=	56.49
Subtotal of inventory cost per year	=	112.98
Material cost per year	=	2494.53
Total cost per year	=	2607.52

Quarterly Order Quantity Analysis:

Assigned order quantity	=	26
Order interval(yr)	=	.25
Ordering cost	=	64.61
Holding cost	=	49.39
Subtotal of inventory cost per year	=	114.00
Material cost per year	=	2494.53
Total cost per year	=	2608.54
Diff b/t EOQ and Quarterly Qty	=	1.02

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-Item:	Ashtray	Unit of Issue:	Case
Demand per year (D)	=	11	
Order or setup cost per order (Co)	=	16	
Holding cost per unit per year (Ch)	=	3.44	
Unit cost (C)	=	21.50	

Economic Order Quantity Analysis:

EOQ	=	10.11
Order interval(yr)	=	0.92
Ordering cost	=	17.39
Holding cost	=	17.39
Subtotal of inventory cost per year	=	34.79
Material cost per year	=	236.50
Total cost per year	=	271.29

Quarterly Order Quantity Analysis:

Assigned order quantity	=	2
Order interval(yr)	=	0.18
Ordering cost	=	88.00
Holding cost	=	3.44
Subtotal of inventory cost per year	=	91.44
Material cost per year	=	236.50
Total cost per year	=	327.94
Diff b/t EOQ and Quarterly Qty	=	56.65

Total Quarterly Order Quantity Cost	=	88,160.29
Total Economic Order Quantity Cost	=	85,416.14
		<hr/>
Difference b/t EOQ and QOQ Cost	= \$	2,744.15

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